Director's Series on

PROLIFERATION

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Director's Series on Proliferation

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Contents

1

GPS-Guided Cruise Missiles and Weapons of Mass Destruction

*Dr. Irving Lachow**

In the last few years, interest in the problem of cruise missile[1] proliferation has grown substantially. One reason for this interest in cruise missiles, especially land-attack cruise missiles, is that less-developed nations can use the United States' global positioning system (GPS) to obtain high navigation accuracies. While there is general agreement among analysts that GPS-guided cruise missiles (GCMs) pose a potential threat to US security, little work has been done to quantify that threat. This paper assesses the future role of GCMs as carriers of weapons of mass destruction (WMD)[2] and examines some options available to Third World nations seeking to acquire or develop GCMs. The strengths and weaknesses of different types of cruise missiles are examined, and the capabilities of GCMs for WMD delivery are compared with those of aircraft and ballistic missiles. By determining the relative advantages and disadvantages of GCMs vis-a-vis other delivery vehicles, we can gain insights that will allow us to make educated guesses regarding the future role of GCMs.

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[1]In this article a cruise missile is defined as, "an unmanned, self-propelled vehicle that sustains flight through the use of aerodynamic lift over most of its flight path." This definition is taken from Article II of the "Treaty between the United States of America and the Union of Soviet Socialist Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles," reprinted in *Arms Control Today*, Vol. 18, No. 1 (January/February 1988).

[2]The threat posed by conventionally armed GCMs was explored in earlier research. See Irving Lachow, "The Global Positioning System and Cruise Missile Proliferation: Assessing the Threat," *CSIA Discussion Paper 94-04* (Kennedy School of Government, Harvard University, June 1994).

The paper is organized into six sections. The first provides background material on GPS. The second section describes the four paths that Third World nations could follow to acquire land-attack cruise missiles: direct purchase from other countries, indigenous development, modification of anti-ship cruise missiles and unmanned aerial vehicles, and the creation of "poor man's cruise missiles" by placing GPS equipment on "generic" airframes such recreational aircraft.[3] The third section examines the survivability of GPS-guided cruise missiles—that is, their ability to penetrate enemy defenses to reach a target. The fourth section analyzes the ability of GCMs to deliver nuclear, biological, and chemical (NBC) payloads to a target. The fifth section compares the capabilities of these delivery vehicles with those of aircraft and ballistic missiles. The final section summarizes the findings of this article and examines their implications for policy-makers.

Background

The global positioning system consists of 24 NAVSTAR satellites in high-altitude orbits around the earth. These satellites transmit coded radio signals that allow anyone with a receiver to determine his or her position (latitude, longitude, and altitude) on the earth with a horizontal accuracy of 15 to 100 m.[4] GPS can also provide accurate measurements of velocity down to 0.1 knots. The system is operational 24 hours a day, has all-weather capability, and provides global coverage.

The GPS works by timing how long it takes coded radio signals to reach the earth from its satellites. A receiver does this by generating its own set of timing signals that are identical to those being transmitted by the satellites. A receiver can then determine the time delay between its codes and the codes received from the NAVSTAR satellites by seeing how far it must move its own codes to match those transmitted by the satellites.

Once a receiver has calculated the time it takes a satellite's signals to reach its position, it multiplies that travel time by the speed of light to determine its distance to the satellite. Thus, in theory, a GPS receiver

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[3]A cruise missile of this type would be inexpensive and easy to acquire, hence the nickname: "poor man's cruise missile."

[4]Unless otherwise stated, all accuracies in this article are expressed in terms of $2d_{rms}$. The $2d_{rms}$ measure usually corresponds to a 95% probability (unless otherwise indicated), depending on one's assumptions about the distribution of the position errors. In other words, someone with a horizontal accuracy of 100 m ($2d_{rms}$) has a 95% probability of actually being within 100 m of where they think they are. The vertical position errors of GPS are larger than the horizontal ones because of the geometry of the satellites.

could calculate its three-dimensional position by measuring its distance from three different satellites. However, in practice, four satellites are used. The fourth satellite is necessary because there is a timing offset between the clocks in a receiver and those in a satellite. The clocks on GPS receivers are not perfectly in time with those aboard the NAVSTAR satellites. The fourth measurement allows a receiver's computer to solve for the timing offset and eliminate it from the navigation solution.[5]

The GPS satellites actually transmit two different codes; the Precision or P-code and the Coarse/Acquisition or C/A-code. The P-code is designed for military users. It is more accurate than the civilian code and is more difficult to acquire and jam. The C/A-code is designed for use by nonmilitary users. It is less accurate than the P-code, easier to acquire, and easier to jam. To ensure that unauthorized users do not acquire the P-code, the United States implemented an encryption segment on it.[6] The new code, designated Y-code, will now be available only to users with the correct deciphering chips.

In ideal conditions, GPS has an accuracy of approximately 20 to 30 m with the C/A-code. Fearing that the level of accuracy associated with the C/A-code could threaten US national security interests, the Department of Defense included a feature in GPS called Selective Availability (SA) that introduces an artificial error into the C/A-code. Authorized receivers have chips that can adjust for the artificial error, but civilian receivers do not. The resulting signal that is available to the civilian community is known as the Standard Positioning Service (SPS). The SPS provides users with accuracies of about 100 m horizontally and 140 m vertically.[7] The US government announced that the SPS would become available beginning in 1993, "on a continuous, worldwide basis with no direct user charges for a minimum of ten years."[8]

The signal that is available to authorized foreign and military users—the encrypted P-Code—is known as the Precise Positioning Service (PPS). It provides users with accuracies of 21 m horizontally and 29 m vertically.

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[5]An excellent explanation of this process is provided in Jeff Hurn, *GPS: A Guide to the Next Utility* (Sunnyvale, CA: Trimble Navigation, 1989), pp. 14–34.

[6]The encryption segment was implemented on January 31, 1994.

[7]The specifications are taken from the Department of Defense and Department of Transportation, *1992 Federal Radionavigation Plan* (Washington, DC: Department of Defense and Department of Transportation, 1992), p. A-38.

[8]*1992 Federal Radionavigation Plan*, p. 3-43.

Differential GPS

Differential GPS (DGPS) is a method of operating GPS that allows a user to obtain extremely high accuracies. The concept behind DGPS is simple. A receiver is placed at a surveyed location (i.e., a location whose position is known precisely). The GPS signals arriving at that location contain errors that offset the position of the surveyed point by some amount. The errors in the GPS signal are determined by comparing the site's known position with its position according to GPS. Correction terms can then be calculated and passed on to the user. Those correction terms allow the user to eliminate many of the errors in the GPS signal.[9]

Because SA works by introducing artificial bias errors into the satellite signal (the satellite clock signal is "dithered," and the position of the satellites is misrepresented), DGPS is very successful at canceling out the SA degradation. The accuracy of DGPS positioning varies, depending on the user's range from the ground station, the timeliness of the corrections, the geometry of the satellites, and the user's equipment. However, most sources report accuracies in the 1- to 5-m (1s) range.[10]

Despite its benefits, DGPS does have some limitations. Its primary limitation is that both the user and the DGPS reference receiver must be looking at the same set of satellites. This requirement limits the range and time interval during which DGPS corrections are useful. The range of DGPS corrections is also highly dependent on the frequency of the transmissions. It is reasonable to assume that most users will be able to employ differential correction for ranges of 200 to 400 km from a reference station.

A solution to the range limits facing DGPS has been developed by several private companies and is known as wide-area DGPS (WADGPS). WADGPS is similar to local DGPS except that many reference stations are used to collect differential corrections over a wide area. The corrections are sent to a central facility that links them with satellites.[11] The satellites can then broadcast those corrections to paying users who are within the area of coverage. Because users are receiving their corrections from satellites rather than from ground stations, they can travel long distances (e.g., across continents) without losing DGPS guidance.

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[9]All bias errors are eliminated. The remaining errors vary randomly and therefore cannot be corrected in this manner. Fortunately, the random errors contribute little to a user's position uncertainty; that is why DGPS signals are so accurate.

[10]See, for example, W. Hundley et al., "Flight Evaluation of a Basic C/A-Code Differential GPS Landing System for Category I Precision Approach," *Navigation: Journal of the Institute of Navigation*, Vol. 40, No. 2 (Summer 1993), pp. 161–178.

[11]Some companies such as Acc-Q-Point and Differential Corrections Inc. transmit their corrections via FM subcarriers.

GPS and Cruise Missile Guidance

To see why GPS can have such a significant impact on cruise missile proliferation, one must understand the inherent limits of inertial navigation systems (INSs).[12] Although INS packages are commercially available and have the advantage of being jam-proof, they have one major drawback: The physical forces affecting the gyroscopes and accelerometers used in inertial navigation systems create errors that accumulate over time. The navigation errors due to inertial drift are large enough to undermine the military utility of INSs for all but short-range missions. To illustrate this point, Figure 1 shows the circular error probable (CEP) as a function of inertial drift for three inertial navigation systems and compares these accuracies with the accuracy provided by GPS.[13]

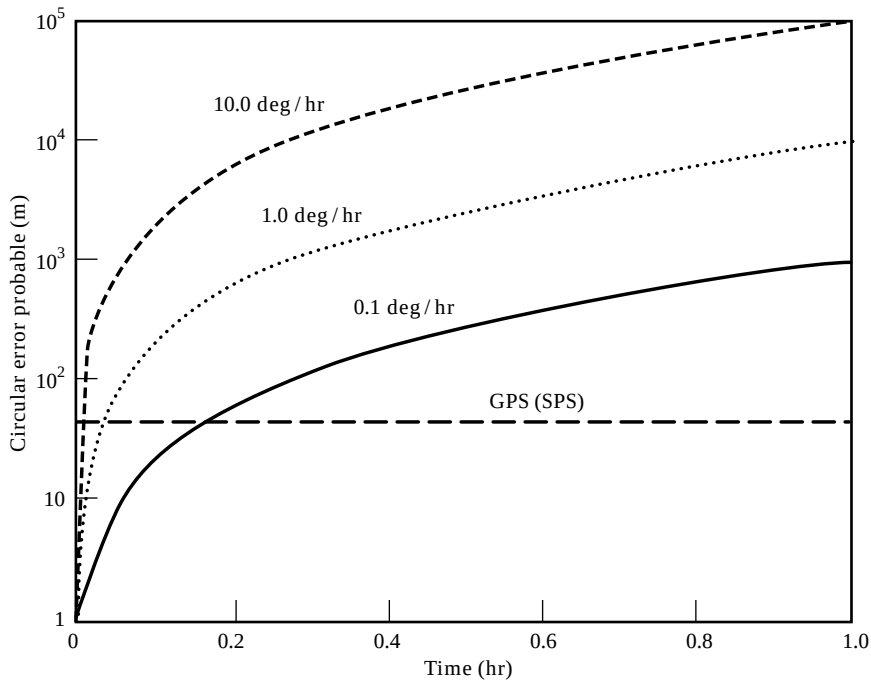

Figure 1. Navigation errors for inertial navigation systems and GPS.[14]

[12]An inertial navigation system consists of gyroscopes, accelerometers, and some type of processor.

[13]Figure 1 shows the accuracy available to civilian users when selective availability is turned on. The CEP (circular error probable) of a weapon or vehicle is a measure of horizontal accuracy; it expresses the radius within which an object will be 50% of the

The drift error of the 10-deg/hr INS surpasses the position error of GPS almost immediately. The drift error for the 1-deg/hr INS surpasses the GPS error in approximately 2 minutes. If the 0.1-deg/hr INS is used, the two errors are equal after 10 minutes. In assessing the availability of these systems, note that the 10-deg/hr INS is an extremely low-quality system; a less-developed country (LDC) will almost certainly be able to do better. The 1-deg/hr INS is very close to the limit of what an LDC could purchase legally. The 0.1-deg/hr INS is a high-quality system that falls under export restrictions.

Figure 1 shows why even the United States, which possesses the most advanced INSs in the world, had to develop the terrain contour matching system (TERCOM) to update the inertial guidance systems on its long-range Tomahawk cruise missiles.[15] Third World nations are further restricted by the fact that exports of high-accuracy gyroscopes, accelerometers, and INSs are controlled under the Missile Technology Control Regime (MTCR).[16] The United States also places unilateral controls on exports. For example, licenses are required for gyroscopes with drift rates of 0.1 deg/hr (at linear accelerations of less than 10 g) and INSs with navigation errors of 0.8 nmi/hr (CEP).[17]

It is obvious that cruise missiles traveling for longer than a few minutes would be much more accurate if they used GPS for their guidance

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time. For example, if 100 missiles with a CEP of 30 m were launched at a target, 50 of those missiles would land within 30 m of the target.

[14]The graph is based on an inertial navigation model found in Edward R. Harshberger, *Long-Range Conventional Missiles: Issues for Near-Term Development,* N-3328-RGSD (Santa Monica, CA: RAND Graduate School, 1991) p. 121. Although the model expresses its navigation errors in deg/hr rather than nmi/hr, the model does include the errors due to both gyroscopes and accelerometers. An excellent discussion of all the errors that must be included in such a model is given in Morris M. Kuritsky and Murray S. Goldstein, Eds., "Inertial Navigation," *Proceedings of the IEEE,* Vol. 71, No. 10 (October 1983), pp. 1156–1176.

[15]The chances that an LDC could develop a terrain-matching guidance system are remote. The technical complexity and massive infrastructure required to use a TERCOM-like system are daunting. In addition, terrain matching technologies are export controlled. See Harshberger, *Long-Range Conventional Missiles,* pp. 46–52.

[16]The MTCR is a nonbinding agreement that limits the sale of all types of missiles with ranges greater than 300 km, regardless of their payload. Originally, the MTCR guidelines applied to delivery vehicles with ranges in excess of 300 km and payloads larger than 500 kg. The guidelines were changed on January 7, 1993. See Ian Anthony et al., "Arms Production and Arms Trade," *SIPRI Yearbook 1993: World Armaments and Disarmaments* (Oxford: Oxford University Press, 1993), p. 464. A more detailed description of the MTCR is found in: Ian Anthony, Ed., *Arms Export Regulations* (Oxford: Oxford University Press, 1991), pp. 219–227.

[17]*Code of Federal Regulations (CFR),* (Washington, DC: Office of the Federal Register National Archives and Records Administration, 1993), Vol. 15, Ch. VII, Part 799, Sec. 799.1, Item 7A03A.

rather than inertial navigation. However, a GCM relying solely on GPS will lose all of its navigation information if the GPS receiver is jammed or fails for some reason. This vulnerability seriously undermines the military utility of stand-alone GPS guidance for cruise missiles. The most effective strategy a developing nation could adopt for military missions would be to integrate a GPS receiver with an inertial navigation system.

Paths to Acquisition

LDCs could take one of four possible approaches to acquire land-attack cruise missiles. They could purchase advanced cruise missiles from developed nations, develop a missile indigenously, modify vehicles such as unmanned aerial vehicles and anti-ship cruise missiles for land-attack roles, or create poor man's cruise missiles.

Direct Purchase

High-quality land-attack cruise missiles have been produced by France, Israel, Sweden, the United States, and the former Soviet Union (FSU).[18] So far, the MTCR has restricted purchases of missiles from these nations. Of the nations that have developed advanced land-attack cruise missiles, only Israel has not declared support for the regime. However, the prospects for LDCs hoping to purchase advanced cruise missiles appear to be improving:

> *For a glimpse of possible future transfers, one need only consider Russia's offering of a shorter range version of the 3000-km range AS-15 cruise missile [which is nuclear-capable] at the February 1993 Abu Dhabi Defense Exhibition, or the French* Apache *stealth cruise missile, which was on display for export at air shows in Paris (June 1993) and Singapore (February).*[19]

Indigenous Development

At present, only one land-attack cruise missile has been developed outside of the West: the Israeli Popeye. There were reports before the

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[18]W. Seth Carus, *Cruise Missile Proliferation in the 1990s*, The Washington Papers #159 (Westport, CT: Praeger, 1992), pp. 126–140. The most capable systems belong to France, the United States, and the FSU.

[19]K. Scott McMahon and Dennis M. Gormley, *Controlling the Spread of Land-Attack Cruise Missiles* (Marina del Rey, CA: American Institute for Strategic Cooperation, January 1995), p. 14.

Gulf War that Iraq was working on a cruise missile called the Ababil, but the current status of that program is unknown.[20]

There are two reasons why few capable land-attack cruise missiles have been developed in the Third World: technological obstacles and export controls. Building a capable land-attack cruise missile is not easy. A cadre of highly trained personnel and a large technical infrastructure are required. In addition, developing a cruise missile is time-consuming and expensive. Aside from the guidance problem, engineers must deal with propulsion, the materials for the missile body, and the flight control system. After a cruise missile is built and tested, mission planners must obtain targeting information and terrain elevation data to decide which route the cruise missile will take to its target. Clearly, Third World nations face many technical obstacles if they hope to develop and successfully use their own advanced land-attack cruise missiles. However, as more developing nations gain experience building aircraft, these problems may diminish.

Export controls contribute to the difficulty of the task faced by Third World engineers by restricting access to key technologies that are required for developing advanced cruise missiles. For example, the following groups of technologies are covered by the US Export Administration Act:[21]

1. Materials.
2. Materials processing.
3. Electronics.
4. Computers.
5. Sensors.
6. Avionics and navigation.
7. Propulsion systems and transportation equipment.

Despite the obstacles described above, at least two LDCs appear to be developing advanced cruise missiles indigenously: China and India. Both nations have large numbers of highly trained personnel and fairly advanced technical infrastructures (e.g., both have developed space-launch vehicles and nuclear weapons). Also, both countries have motivations to develop advanced cruise missiles: geo-political concerns, a desire to demonstrate that they can keep up with the developed world, a wish to create a weapon program independent of imported technologies, and perhaps, the potential profits of export sales.

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[20]Carus, *Cruise Missile Proliferation*, p. 40.

[21]*15 CFR*, Ch. VII, Part 799, Section 799.1, (b) (1).

Modification of Other Platforms

Another option available to LDCs is to convert anti-ship cruise missiles, unmanned aerial vehicles (UAVs), and remotely piloted vehicles (RPVs) into GCMs. These systems are easily purchased. Anti-ship cruise missiles are produced by at least 13 nations and are owned by 70 countries, including 40 in the Third World.[22] One reason for the ubiquity of these missiles is that they are generally designed for short ranges and thus are not covered by the MTCR. However, anti-ship cruise missiles often carry substantial payloads to cripple or sink large ships.

Unmanned aerial vehicles are generally used for battlefield surveillance and reconnaissance. Hence, they are usually designed to carry small payloads such as cameras, which are often placed on or under their wings. UAVs can have long ranges, but the primary characteristic that concerns military planners is their loiter time over a given target. Thus, UAVs are usually built to stay in the air for long periods of time—a characteristic that does not necessarily translate into long ranges because these vehicles often circle at very slow speeds.

Given these reservations, it appears possible for less-developed nations to convert some UAVs into cruise missiles. For example, Argentina is attempting to convert an Italian Mirach-100 reconnaissance drone into a land-attack cruise missile known as the MQ-2 Bigua.[23] The next-generation Mirach, called the Mirach-600, will be a much more capable delivery system. It will be able to carry 300- to 500-kg payloads out to a range of more than 2000 km and will have a velocity of 1100 kph.[24]

It is not clear how readily LDCs will be able to convert anti-ship cruise missiles into land-attack cruise missiles. Anti-ship cruise missiles generally use INSs for midcourse guidance and then either active radar or television links for the terminal approach. Cruise missiles with active radar will not be accurate in land-attack roles because radar returns from a desired target will be difficult to identify. Land-attack cruise missiles using TV guidance will be limited to short ranges and may require an operator in an aircraft to be nearby, which would be undesirable in many situations. The obvious solution to these problems would be to replace an anti-ship cruise missile's original guidance package with a

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[22]Carus, *Cruise Missile Proliferation*, pp. 14, 34.

[23]Ibid., p. 41. The Mirach is not a typical UAV because it is designed for "strike" missions as well as for surveillance, reconnaissance, target location and acquisition, electronic warfare, and defense saturation. See Kenneth Munson, *World Unmanned Aircraft* (New York: Jane's Publishing Inc., 1988), p. 65.

[24]Ibid., p. 66.

GPS receiver. However, this action would require a subsequent change in a missile's software and hardware. The same difficulty might be faced in converting some UAVs.

In sum, there are challenges in converting anti-ship cruise missiles and unmanned aerial vehicles into GCMs; however, they are challenges that might be overcome. In either case, the characteristics of these vehicles themselves—anti-ship cruise missiles have short ranges and medium to large payloads, while UAVs have longer ranges and smaller payloads—may limit their utility in battlefield situations. That situation may change in the future if systems like the Mirach-600 proliferate.

Development of Poor Man's Cruise Missiles

A final approach that LDCs could take is to integrate autonomous GPS guidance packages into the airframes of existing aircraft. This option has numerous advantages. First, poor man's cruise missiles could be relatively inexpensive compared with the cost of either developing or purchasing advanced cruise missiles. Third World nations could also use the airframes of old fighter aircraft they already possess.[25] For example, during the Gulf War, US intelligence discovered that Iraq had developed three radio-controlled MiG-21 drones that were outfitted for chemical weapon (CW) dispersal.[26] Second, this approach would allow LDCs to take advantage of the excellent range/payload capabilities of most aircraft. Even home-built aircraft can carry several hundred kilograms to ranges of several hundred kilometers (see Table 1). Third, the deployment of such cruise missiles would be easy to hide from adversaries.

A significant drawback to this strategy is that many recreational aircraft and old fighter planes have fairly substantial radar cross sections. Cruise missiles created from such airframes would be more easily detected by enemy radars than either advanced cruise missiles or those based on UAVs. On the other hand, it appears that many ultralight airframes have fairly small radar cross sections (see the section on Detection).

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[25]See International Institute for Strategic Studies (IISS), *The Military Balance 1993–1994* (London: IISS, 1993).

[26]Rick Atkinson, *Crusade: The Untold Story of the Persian Gulf War* (Boston: Houghton Mifflin, 1993), p. 223. Although MiG-21s are not state-of-the art aircraft (they basically use 1950s technology), they are capable of flying at supersonic velocities at both high and low altitudes. They can also carry two 500-kg bombs and two 250-kg bombs to ranges of greater than 1000 km (the specific range depends on the altitude and velocity at which the plane flies).

Table 1. Characteristics of poor man's cruise missiles.[a]

	Sonerai II	CitationJet	MiG-21
Range (km)	560	2780	2000–3000
Payload (kg)	300	2940	1500
Cost	$5300	$2.6 million	?

[a]All data were taken from *Jane's All the World's Aircraft* (Surrey, UK: Jane's Information Group Ltd., 1992) except the cost estimate for the CitationJet, which was obtained from Forecast International and provided courtesy of Will F. Schaefer of the Mitre Corporation.

An airframe that exceeds the MTCR range/payload limits can be obtained for the price of a used car. Given the low cost of GPS equipment, computers, and autopilot devices, it is conceivable than a GCM could be created for less than $10,000. Of course, if one placed high-quality inertial navigation systems and accurate altimeters on a home-built airframe, the cost of such a "missile" would rise considerably. However, it is clear than an LCD could create a capable GCM for much less than $1 million.

Survivability

The survivability of cruise missiles depends on two factors: how easy they are to detect, and how easy they are to intercept once they are detected. Both issues are discussed below.

Detection

A crucial element of a cruise missile's survivability is its observability. The usual variable used to measure a vehicle's observability is its radar cross section (RCS). The higher the RCS, the easier it is for a radar to "see" an object. Table 2 gives some typical RCS values for aircraft and cruise missiles.[27]

The numbers given in Table 2 are notional; the RCS of such vehicles can be larger than the numbers quoted here if the vehicles are not optimally designed. A poor man's cruise missile will probably have an RCS in the 1- to 6-m^2 range, depending on the airframe. Cruise missiles created from UAVs may have radar cross sections of less than 1 m^2. A more

[27]Estimates for the RCSs of the aircraft are taken from Merrill I. Skolnik, *Introduction to Radar Systems* (New York: McGraw-Hill, 1980), p. 44. The RCS of the Tomahawk is from George N. Lewis and Theodore A. Postol, "Long-Range Nuclear Cruise Missiles and Stability," *Science & Global Security*, Vol. 3, Nos. 1–2 (1992), p. 56. Also, the reader should be aware that RCS varies with the frequency of the radar and the angle at which the targets are illuminated.

Table 2. The radar cross section of various vehicles.

Vehicle	Radar cross section (m^2)
Boeing 747	100
Large bomber or jetliner	40
Medium bomber or jetliner	20
Large fighter	6
Small fighter or 4-passenger jet	2
Small, single-engine aircraft	1
Tomahawk-like cruise missile	0.1

advanced cruise missile, especially one employing stealth technologies, could have an RCS of 0.1 to 0.01 m^2.

To see how important a cruise missile's radar cross section is, one can calculate the range at which such missiles may be seen by airborne warning and control system (AWACS) aircraft (ignoring the problem of ground clutter). The AWACS was designed to detect fighters with radar cross sections of 7 m^2 at a range of at least 370 km.[28] Using this specification to establish the performance of the AWACS radar, one finds that a 1-m^2 target will be detected at a range of about 230 km, and a 0.1-m^2 target will be seen at a range of 130 km.[29] Clearly, if developing nations were able to obtain low-observable technologies, the potential threat of cruise missiles would grow substantially.

Finally, a cruise missile's altitude is extremely important because it determines the line-of-sight limit at which ground-based radars will be able to see the missile. The lower a GCM flies, the shorter a radar's horizon. For example, a cruise missile flying at a height of 1000 m can be seen by a ground-based radar at a distance of 130 km, whereas a missile flying at 100 m can be seen at a range of 40 km.[30] Thus, to detect low-flying missiles at long ranges, a defender must use an airborne platform. Although airborne radars can potentially detect low-flying cruise missiles at long ranges, they face their own set of obstacles (which are discussed below).

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[28]David Hughes, "USAF Will Develop Major Radar Upgrade for Its E-3 AWACS Fleet," *Aviation Week & Space Technology* (January 23, 1989), p. 49.

[29]These estimates are made by using the fact that a radar's detection range is a function of a target's RCS raised to the one-fourth power. Hence, the difference in detection range between a target with an RCS of 7 m^2 and one with an RCS of 1 m^2 is $7^{0.25}$ or a factor of 1.6. Dividing 370 km by 1.6 yields a detection range of 228 km.

[30]These are the ranges at which a radar has a clear line-of-sight to a target; however, a radar may not immediately detect a target it can see. The detection range of a radar against a specific target depends on the target's RCS and velocity and on the characteristics of the radar (such as its power-aperture product and its processing capabilities).

Another factor that affects a cruise missile's survivability is the velocity at which it flies. This variable is important for three reasons: It can affect the ability of a defensive system to engage the missile; it determines how long an INS will drift after a GCM is jammed; and most importantly, it affects the probability that the missile will be detected by airborne radars.

Airborne platforms such as AWACS attempt to detect enemy vehicles by looking for movement that stands out from background clutter.[31] They do this by measuring a vehicle's Doppler shift, which is proportional to the relative velocity between it and the radar.[32] Thus, the shift for ground clutter will be due to the motion of the radar platform only.[33] In contrast, returns from a cruise missile moving toward the radar will experience a shift as a result of both the missile's velocity and that of the radar platform. Hence, the missile's Doppler shift will be in a region that is not occupied by ground clutter. The greater the velocity of the attacking missile, the more visible it will be. By the same token, the smaller the radial velocity of the missile, the harder it is for an airborne radar to distinguish the moving platform from the clutter. The same problem arises if a target is not moving toward an AWACS (e.g., if it is moving perpendicular to the aircraft). In that case, the relative velocity of the missile will be in the same region as the ground clutter, which will make it harder to pick out the Doppler shift caused by the missile.

Because most airborne radars are optimized to detect aircraft, they are not designed to handle targets moving at very slow speeds. The minimum velocity that these radars can detect is often called their Doppler notch. A cruise missile traveling at velocities below this threshold will not be detected. Most airbreathing platforms fly fast enough to be seen

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[31]When airborne radars look down toward the ground, they receive returns from the terrain. These radar returns are called clutter.

[32]The Doppler shift (f_d) due to a moving object is given by:

$$f_d = \frac{2v}{\lambda},$$

where:

v = the relative velocity between an object and the radar platform, and

λ = the wavelength of the radar.

See John C. Toomay, *Radar Principles for the Non-Specialist* (New York: Van Nostrand Reinhold, 1989), p. 89.

[33]Other types of clutter that can be problematic include clouds, rain and wind. See Curtis D. Schleher, *Introduction to Electronic Warfare* (Dedham, MA: Artech House, 1986), pp. 213–215; and William W. Shrader, "MTI Radar," in Skolnik, *Radar Handbook*, pp. 17-9–17-11.

by AWACS, but some microlight aircraft can fly as slow as 40 kph. It is doubtful whether an AWACS, or a fighter plane for that matter, would be able to detect such a slow-flying target.[34] Thus, LDCs have some incentive to develop slow, inexpensive cruise missiles that might be effective against nations like the United States.

Interception

Once GCMs are detected, many of them will probably be easy to shoot down because cruise missiles do not generally carry electronic countermeasures or weapons. Hence, they will be sitting ducks for aircraft and surface-to-air missiles (SAMs). On the other hand, some GCMs may pose a challenge for air defenses. For example, slow-flying missiles may be hard for aircraft to intercept, particularly if they are flying at low altitudes.[35] Low-flying cruise missiles could also pose problems for air defense systems such as the Patriot, which is designed to intercept medium- to high-altitude targets. Such missiles will be quite vulnerable to ground-based air defenses such as anti-aircraft artillery, but these defenses will only be useful at very short ranges. Thus, they will be easy to saturate.

In fact, a concentrated attack on a specific target by a large number of cruise missiles might even pose a problem for US forces. For example, if 20 or 30 GCMs attacked a given SAM cite, that air defense unit might not be able to simultaneously track and intercept all of the missiles. The feasibility of this strategy for an attacker depends on the specifics of a given situation (e.g., the number of cruise missiles available, their physical characteristics, the type and number of air defenses, and the type and number of targets) and the costs of this plan relative to other strategies. However, from the point of view of Third World nations, saturation attacks appear to be a good strategy if individual missiles are inexpensive.[36]

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[34]Because US aircraft often operate over roads and highways, their radars are designed to "ignore" ground traffic. If this were not done, the aircraft would see hundreds of potential targets on their radars, and the task of discriminating between enemy aircraft and friendly or neutral vehicles would be extremely difficult.

[35]High-flying, supersonic cruise missiles could also be difficult to intercept.

[36]An LDC could also launch both ballistic and cruise missiles against enemy targets simultaneously. The different characteristics of these two vehicles—ballistic missiles would be high-velocity, high-altitude targets while cruise missiles would be low-velocity, low-altitude targets—could stress the abilities of the most advanced air defenses.

Lethality

The lethality of a cruise missile is a function of its accuracy, range and payload, which are discussed in this section.

Accuracy

The overall accuracy of cruise missiles using GPS for guidance is equally dependent on two factors: the navigation accuracy of the missiles, and their knowledge of a target's location. The former variable is described in Table 3.

Table 3. Navigation accuracy (in meters) using GPS.

	SPS	SA off	PPS	DGPS
Horizontal ($2d_{rms}$)	100	30	21	10
Vertical ($2d_{rms}$)	140	42	29	14
Horizontal (CEP)	42	13	9	4

One can see that the CEP of a GCM is highly dependent on the type of GPS signals being used. Third World nations are currently able to use either the SPS or DGPS.

The other variable affecting a cruise missile's overall accuracy is the mission planner's knowledge of a target's location. The ability of LDCs to locate enemy assets depends critically on the nature and location of the target. Support facilities and certain infrastructure targets are easy to locate, whereas mobile targets may be hard to track down without real-time satellite imagery. Because cruise missiles carrying weapons of mass destruction would probably be used against either large military targets such as airbases, critical infrastructure targets such as ports or airports, or large population centers, it appears unlikely that targeting errors will be a serious limitation for GCMs carrying NBC payloads.[37]

Range and Payload Tradeoffs

Range and payload have been grouped into a single category because the two characteristics are closely related: A delivery vehicle is designed to carry a certain payload over a given distance. If a missile's payload is lightened, the range of that vehicle can be extended. The payload of a delivery system is simply the amount of "weapon" the system can carry. Attackers usually want to maximize the payload of their weapons to cause the most damage possible to the enemy. However, the relationship between a weapon's size and the amount of damage it can do

[37]On the other hand, targeting errors play a critical role for conventionally armed cruise missiles. See Lachow, *GPS and Cruise Missile Proliferation*, pp. 31–43.

depends on the physical characteristics of the weapon. For example, the amount of damage one can cause with high explosives is highly dependent on the size of the warhead. The same is true of chemical and biological weapons (CBW). In contrast, the lethality of nuclear weapons is not directly dependent on the physical size of the weapons; small nuclear devices can be quite devastating.[38] However, because nuclear weapons must have a critical mass of either highly enriched uranium or plutonium in order to function properly, there is a weight threshold below which nuclear weapons are not likely to exist (see the section on nuclear weapons).

The range of a delivery vehicle is important because it determines which targets are within reach. The range that a given nation requires for its missiles is highly dependent on its geo-political situation. For example, in the Middle East, ranges of several hundred kilometers or less could be considered strategic, whereas the strategic systems of the United States have ranges of several thousand kilometers. Table 4 illustrates this point.

Table 4. Range requirements for various regional theaters.

From	To	Range (km)[a]
Jordanian border	Jerusalem	15
North Korean border	Seoul	<50
Syrian border	Tel Aviv	<100
Iraqi border	Jerusalem	350
Iraqi border	Tehran	525
North Korean border	Japan	600–1200
Libya	Rome	900
Syria	Athens	1200

[a]Sources of range information are as follows: US Congress, Office of Technology Assessment, *Technologies Underlying Weapons of Mass Destruction*, OTA-PB-ISC-115 (Washington, DC: US Government Printing Office, December 1993); and *Rand McNally World Atlas of Nations* (Chicago: Rand McNally & Co., 1988).

It follows that the types of delivery systems a nation will attempt to acquire are highly dependent on the geography of that nation as well as its military and political goals. Targets that are far from a nation will require long-range weapons. Many nations that appear likely to acquire GCMs—Iran, Iraq, North Korea, China, and India—have hostile relations with at least one neighboring country. It seems likely that these

[38]A nuclear device weighing several hundred kilograms can release energy that is equivalent to many thousands of tons (kilotons) of TNT.

nations will want to acquire GCMs with the capability to reach vital targets in their neighboring countries.

Table 5 compares the range and payload characteristics of typical advanced aircraft and ballistic missiles with several types of cruise missiles. The MQ-2 Bigua is a converted UAV; the Sonerai II is a home-built aircraft; and the HY-2 Silkworm is a common Chinese anti-ship cruise missile. Finally, the AS-6 Kingfish is a Russian strategic cruise missile. It can be used either for land-attack or anti-ship missions. It can fly up to Mach 3.5 (almost 4200 kph) and can carry nuclear weapons.

Table 5. Range and payload characteristics of delivery vehicles.[a]

Vehicle	Range (km)	Payload (kg)
MQ-2 Bigua	*900*	*40–70*
Sonerai II	*560*	*300*
HY-2 Silkworm	*95*	*500*
AS-6	*560*	*1000*
Scud B	300	1000
Al-Husayn	600	190
MiG-29	1150[b]	6000–7000
Su-24	1200[b]	8000

[a]Cruise missiles are italicized. Data are taken from: Carus, *Cruise Missile Proliferation*, pp. 126–140; *Jane's Aircraft*, p. 518; and Center for International Security and Arms Control (CISAC), *Assessing Ballistic Missile Proliferation and Its Control* (Stanford, CA: CISAC, 1991), pp. 28–29.

[b]Range is combat radius for a mission with a high-low-high flight profile.

The range of air-launched and sea-launched cruise missiles (ALCMs and SLCMs, respectively) is not entirely dependent on the capabilities of the missiles. Because they are carried aboard larger platforms, the ranges of these cruise missiles can be extended. It follows that even short-range cruise missiles can gain strategic capabilities in certain situations. For example, enemy ships off the coast of the United States could use such cruise missiles to attack targets that lie well beyond the range of that nation's ballistic missiles and aircraft.

Cruise Missile Performance

This section explores the suitability of cruise missiles for delivering weapons of mass destruction.

Chemical Weapons

GPS-guided cruise missiles have several characteristics that make them useful platforms for delivering chemical weapons. They can use spray tanks and nozzles similar to those used in crop dusting to deliver CW in a line pattern. This method of dissemination also allows one to optimize the droplet size of the agent. For example, droplets that are large will settle quickly onto the ground, thus minimizing the area of coverage.[39] If wind conditions are known, the cruise missiles can be programmed to deliver CW at optimal altitudes and speeds to maximize the area of coverage. If wind conditions are not known, the missiles can fly circular (or arced) patterns around the target to ensure some level of coverage.

Another important factor in CW delivery is surprise. Achieving surprise in a CW attack is crucial because passive defenses such as gas masks and protective clothing will minimize the effect of chemical agents. Some of the GPS-guided cruise missiles described above will be hard to detect; hence, they will have a high probability of surprising a target. On the other hand, those GCMs that are easily detected may pose little threat to opposing forces because their slow speeds (relative to ballistic missiles) will provide them sufficient time to don protective clothing or enter into shelters.

Another disadvantage of using cruise missiles for CW delivery is that the amount of agent they can carry is limited. Table 6 illustrates the area covered by various cruise missiles delivering sarin (GB) on a target.

Table 6. Lethal area covered by cruise missile-delivered sarin (in km^2).[a]

	Weather conditions		
Delivery vehicle	**Clear/sunny day**	**Overcast day/night**	**Clear, cool night**
Bigua (50 kg)	0.015–0.024	0.019–0.032	0.012–0.22
Sonerai II (300 kg)	0.09–0.14	0.11–0.19	0.72–1.3
Silkworm (500 kg)	0.15–0.24	0.19–0.32	1.2–2.2
Kingfish (1000 kg)	0.29–0.48	0.37–0.63	2.4–4.3

[a]These estimates are derived from Fetter, *Missiles and WMD*, p. 21. It is assumed that the lethal dose (LCt_{50}) of Sarin is 70 mg-min/m^3.

[39]See Steve Fetter, "Ballistic Missiles and Weapons of Mass Destruction," *International Security*, Vol. 16, No. 1 (Summer 1991), pp. 18–19.

One can see that the small payloads of many cruise missiles limit their coverage to areas much smaller than a square kilometer. While small coverage areas may be adequate for some targets such as command posts or radars, they will not be sufficient for attacks against larger targets such as airfields, ports, and large battlefronts. Because the latter targets are the most likely ones for chemical attacks, the payload limit of some cruise missiles could be a problem unless a large number of cruise missiles were used.

In comparing cruise missiles with other delivery vehicles, it is important to note that aircraft are able to carry larger payloads than most cruise missiles, and that a pilot can adjust for changing wind conditions.[40] However, aircraft have several disadvantages. They are probably less likely to surprise a target because they are easier to detect with radar. Once they are detected, they may be harder to shoot down than some cruise missiles. However, the loss of one advanced aircraft could cost $20 to $40 million dollars, not including the loss of a well-trained pilot—an exceedingly scarce commodity in many Third World airforces.

Ballistic missiles offer the advantage of having the highest probability of penetrating enemy defenses, and their high velocities give adversaries little time to react. On the other hand, ballistic missiles are easily detected, and a few minutes warning may be enough time for personnel under attack to don masks and protective clothing. Ballistic missiles also have limited range/payload capabilities compared with those for aircraft and some cruise missiles. Finally, cruise missiles can deliver CW in a more efficient manner than ballistic missiles.[41]

In summary, GCMs have several characteristics that make them desirable vehicles for delivering CW. Attacks by small, inexpensive, slow-flying GCMs could be quite effective, especially at night when they will be hard to see visually, and when the effectiveness of the chemical agent will be greatest.

Biological Weapons

Delivery of biological weapons (BW) is similar to that of chemical weapons. However, one important difference between these two

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[40]It should be possible to program cruise missiles to measure wind speeds during their flight; however, a human pilot would be better able to adjust for shifting winds.

[41]To disseminate chemical agents, ballistic missiles using bulk-fill warheads must detonate the warhead with explosive material. The resulting explosion may destroy a significant portion of the chemical payload. See OTA, *Technologies Underlying WMD*, p. 34 (cited in Table 4). In addition, their velocity can be much better suited for delivering chemical weapons than that of ballistic missiles.

weapons is that the lethality of biological pathogens is much higher than that of chemical agents.[42] This fact is quite clear from Table 7.

Table 7. Area covered by cruise missile-delivered anthrax (in km^2).[a]

	Weather conditions		
Delivery vehicle	**Clear/sunny day**	**Overcast day/night**	**Clear, cool night**
Bigua (50 kg)	10–20	33–50	15–130
Sonerai II (300 kg)	60–120	200–300	90–780
Silkworm (500 kg)	100–200	330–500	150–1500
Kingfish (1000 kg)	200–400	750–1000	300–3000

[a]These estimates are derived from Fetter, *Missiles and WMD*, pp. 25–26. It is assumed that a lethal (LCt_{50}) dose of anthrax is 0.1 mg–min/m^3.

It is evident that even a cruise missile carrying only 50 kg of biological pathogens can easily cover a port or airbase. In fact, cruise missiles with moderate payloads can disseminate anthrax over an entire metropolitan area. Comparing the effectiveness of anthrax and sarin, one can see that the same mass of anthrax will cover an area 400 to 2000 times larger than that covered by sarin.

In assessing the ability of delivery vehicles to disseminate BW, the Office of Technology Assessment (OTA) has stated:

> *Since biological warfare agents are, like chemical ordnance, best disseminated in an aerosol over a wide area, aircraft and cruise missiles are better for delivering them than are ballistic missiles. In addition it is more difficult (but not impossible) to develop ballistic missile warheads in which live biological agents can survive the stresses of space flight and atmospheric reentry*.[43]

Given the advantages that GCMs have over aircraft in terms of both survivability and cost (and possibly accuracy), it appears that cruise missiles may be the delivery vehicle of choice for disseminating biological weapons. It is evident why the OTA stated: "the simultaneous proliferation of biological weapons and cruise–missile capabilities may become a major security threat in the future."[44]

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[42]On the other hand, the effects of these pathogens are often not felt for several days, whereas chemical agents can kill or incapacitate almost immediately.

[43]US Congress, Office of Technology Assessment (OTA), *Proliferation of Weapons of Mass Destruction: Assessing the Risks*, OTA-ISC-559 (Washington, DC: US Government Printing Office, August 1993), p. 52.

[44]OTA, *Technologies Underlying WMD*, p. 98.

Nuclear Weapons

It is possible, but unlikely, that any Third World cruise missiles will be used for nuclear weapons delivery in the near future for several reasons. First, it is doubtful that a nuclear device produced in the Third World would weigh less than 500 kg.[45] There are only three types of cruise missiles that can deliver such a large payload: advanced cruise missiles, poor man's cruise missiles, and the Silkworm anti–ship cruise missile.

If LDCs wished to obtain highly capable cruise missiles for nuclear delivery, they would have to purchase them from the United States, France, or the FSU. None of these nations has ever sold a nuclear–capable cruise missile, although the Russian AS–15 has been shown at air shows. The sale of such missiles would be a clear violation of the MTCR and would likely carry severe political repercussions.

Another option for LDCs is to place nuclear weapons aboard poor man's cruise missiles. The disadvantage of this strategy is that those poor man's cruise missiles that can carry a nuclear payload to reasonable ranges are not highly survivable. Given that Third World nations will probably have few nuclear devices in their stockpile, the survivability of the vehicles they use to deliver their nuclear weapons will undoubtedly be the highest priority.

A final option available to Third World adversaries is to place a nuclear device aboard a Silkworm anti–ship cruise missile. The disadvantage of this approach is that the range of the Silkworm is less than 100 km. Thus, its utility is limited to short–range missions.

Another reason Third World nations might not place nuclear weapons on cruise missiles in the near future is that they gain little advantage by doing so. GCMs have one key advantage over other delivery systems: their accuracy. High accuracy is certainly important for delivering conventional munitions and, to some extent, for chemical and biological weapons, but is it vital for delivering nuclear weapons? The answer is no, unless LDCs want to attack hardened targets such as underground bunkers and command posts. Such attacks are possible, but their likelihood is small. In addition, hardened targets would be well protected, so the survivability of a GCM would have to be high for such an attack to succeed. In the foreseeable future, ballistic missiles will

[45]Eric H. Arnett, "The Most Serious Challenge in the 1990s? Cruise Missiles in the Developing World," in Eric H. Arnett and Thomas W. Wander, Eds., *The Proliferation of Advanced Weaponry: Technology, Motivations, and Responses* (Washington, DC: American Academy for the Advancement of Science, 1992), p. 111.

remain more survivable than those cruise missiles capable of carrying nuclear weapons.[46]

Conclusions

The type of cruise missiles a Third World nation is likely to acquire for delivering weapons of mass destruction is highly dependent on several factors, including the political and military goals of a particular country, its geographic position, and the nature of the enemy it is facing. However, the analyses conducted herein point to some general observations.

- GPS-guided cruise missiles appear to be good platforms for delivering chemical and biological weapons, especially the latter.
- At present, there are few advantages to placing nuclear weapons on GPS-guided cruise missiles. That situation may change if advanced cruise missiles become readily available to less-developed countries.
- Low-technology GPS-guided cruise missiles can be extremely inexpensive and fairly capable. In addition, the slow speeds of some microlight aircraft may make them hard to detect and intercept.

Given these observations, it seems likely that Third World nations will seek to develop poor man's cruise missiles in the next decade. However, less-developed countries will probably attempt to purchase advanced cruise missiles at every opportunity. Their success in this endeavor rests in the hands of the developed world. In the long term (10 to 20 years), it is possible that some LDCs will develop advanced, stealthy cruise missiles. In addition, the probability that some high-technology cruise missiles from developed nations will make their way to the Third World is likely to increase. Finally, it would not be surprising if poor man's cruise missiles remain popular in the long term; they are inexpensive and can perform certain missions quite well.

[46]OTA, *Proliferation of Weapons,* pp. 63–68. Almost all nations that are pursuing nuclear weapons program either have or are attempting to purchase ballistic missiles. Many, if not all, of these states also have advanced fighter aircraft that could deliver nuclear payloads. See Harvey, "Regional Ballistic Missiles," pp. 42–43.

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Emergent Security Issues in South Asia

*Dr. Sumit Ganguly**

Both scholarly and official circles have placed an inordinate emphasis on the dangers that nuclear and ballistic missile proliferation pose in South Asia.[1] This excessive concern about the dangers inherent in the spread of weapons of mass destruction in the region has limited the examination of other emergent security issues, the majority of which are internal conflicts.

The concern with proliferation in South Asia at one level is understandable. The presence of small, vulnerable nuclear forces in a region that has witnessed considerable internal strife and four intrastate conflicts since 1947 may make the region more crisis-prone than other areas. The Indian and Pakistani acquisition of short-range ballistic missiles may further aggravate tensions and may be particularly destabilizing in a crisis situation. In the short run, when both sides are likely to have limited missile capabilities, there could be a premium on preemption. The close proximity of enemy military installations further reduces the flight times of missiles, thereby reducing crisis stability. Finally, weak command, control, communications, and intelligence (C^3I) systems in the region could result in accidental launches.[2]

Although the proliferation of missiles and weapons of mass destruction technologies in South Asia threatens the stability of the region, the

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[1]See for example, Kathleen C. Bailey, *Doomsday Weapons in the Hands of the Many* (Urbana: University of Illinois Press, 1991). Also see *The President's Report to Congress on Progress Towards Nonproliferation in South Asia* (Washington, DC: US Department of State, 1994).

[2]On this point, in the superpower context, see Scott Sagan, The Limits of Safety: Organizations, Accidents and Nuclear Weapons (Princeton: Princeton University Press, 1993). Also see Scott D. Sagan and Kenneth N. Waltz, The Spread of Nuclear Weapons: A Debate (New York: W. W. Norton and Company, 1995).

presence of such capabilities may well have had more complex consequences on the region than those envisaged in both scholarly and official assessments. A limited body of evidence suggests, for example, that the development of incipient nuclear capabilities in South Asia may have had paradoxical consequences for the security of the region. Since the mid-1980s, despite significant provocations, neither Indian nor Pakistani decision-makers have been prepared to launch full-scale conventional conflict, partially because the possibility of escalation to the nuclear level has induced a level of caution.[3] Instead, both sides try to exploit internal conflicts; decision-makers on both sides of the border see the risks of internal unrest as being both controllable and calculable. Thus, there is evidence that Pakistan supports the insurgencies in Punjab and, more recently, in Kashmir.[4] India, in turn, has been exploiting the Sindhi–*muhajir* conflict in the Pakistani province of Sindh. In a sense, then, a variant of Glenn Snyder's concept of the "stability/instability paradox" appears to have arrived in South Asia: Stability at the nuclear level tempts states to pursue destabilizing strategies at other levels.[5] Two recent cases provide some support for this proposition.

The Brasstacks Episode

In the mid-1980s, India was suppressing an insurgency in the northwestern state of Punjab. The roots of this insurgency were essentially indigenous, but Pakistani support greatly widened its scope and destructiveness.[6] Sikh insurgents not only moved freely across a porous border in Punjab, but also received training and weaponry from the Pakistanis—a cause of considerable irritation in New Delhi. Adding to New Delhi's frustrations was its inability to persuade the United States to pressure Pakistan to discontinue supporting the insurgency. The United States was preoccupied with the Afghan conflict and needed Pakistan as a conduit of weaponry to the Afghan resistance.

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[3]It is important to bear in mind that in the absence of documentary evidence, this argument cannot be considered ironclad. Furthermore, it can also be argued that India's overwhelming conventional superiority has deterred Pakistan from attacking India. In fact, I have made this argument elsewhere. See Sumit Ganguly, "Nuclear Issues in South Asia," in W. Thomas Wander, Eric H. Arnett, and Paul Bracken, Eds., *The Diffusion of Advanced Weaponry: Technologies, Regional Implications and Responses* (Washington, DC: American Association for the Advancement of Science, 1994).

[4]Anthony Davis, "The Conflict in Kashmir," *Jane's Intelligence Weekly*, Vol. 7, No. 1 (January 1995), pp. 40–47.

[5]Glenn Snyder, "The Balance of Power and the Balance of Terror," in Paul Seabury, Ed., *The Balance of Power* (San Francisco: Chandler, 1965).

[6]Mark Tully and Satish Jacob, *Amritsar: Mrs. Gandhi's Last Battle* (London: Jonathan Cape, 1985).

In mid-1987, India started preparations for its largest peacetime military exercise, code-named "Brasstacks." This exercise, comparable in size to those conducted by the North Atlantic Treaty Organization (NATO) and the Warsaw Pact, was designed to pursue a number of objectives. One goal, which was closely linked to developing a doctrine of "dissuasion,"[7] was to induct new mechanized formations into the Indian Army and test their effectiveness. An ancillary purpose was to intimidate Pakistan because of its unrelenting support to the Sikh insurgents.[8] India chose intimidation over aggression because it did not want to incur the wrath of the United States.

The direction, size, and potential firepower of the exercise provoked Pakistani misgivings. The location of the exercise, in the desert state of Rajasthan, did not overly distress the Pakistanis, but the east-west axis of the exercise brought them great concern because previous exercises had been north–south. The size of the exercise was also significant. It involved two armored divisions, one mechanized division, and six infantry divisions. Pakistani intelligence drew alarmist assessments of Indian capabilities and intentions, and Pakistani diplomats sought clarification of Indian objectives. Their efforts were either rebuffed or met with prevaricative answers.

The exercise started in late December 1986 and continued into mid-January 1987. During this period, the Pakistan Army was also conducting its winter military exercises, *Saf-e-Shikan* and Flying Horse. Indian civilian intelligence agencies picked up evidence of Pakistani troop and armor movements into a sensitive region near the Indo-Pakistani border, which was within easy striking distance of the Indian city of Amritsar. Military intelligence was unable to confirm these moves; however, given the highly disturbed political situation in the state of Punjab, Indian anxieties were aroused. In a panic, Indian officials publicly expressed concern about these potentially threatening Pakistani troop movements. The public airing of Indian concerns ultimately led to diplomatic consultations between India and Pakistan, mediated by the United States, which lowered the levels of suspicion and tension.[9]

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[7]This doctrine, a brainchild of General Krishnaswami Sundarji, the Chief of Staff of the Indian Army, had many of the hallmarks of Western deterrence theory. The introduction of the mechanized formations would be an important component of the necessary "dissuasive" capabilities. For an early discussion of Exercise Brasstacks and the doctrine of "dissuasion" see Sumit Ganguly, "Getting Down to Brass Tacks," *The World and I* (May 1987), pp. 100–104.

[8]Kanti Bajpai, P. R. Chari, Pervaiz Iqbal Cheema, Stephen P. Cohen, and Sumit Ganguly, *Brasstacks and Beyond* (Urbana: Program in Arms Control, Disarmament and International Security, 1995).

[9]Bajpai et al., *Brasstacks and Beyond*.

Where did the nuclear component enter the crisis? In late January 1987, as the crisis was drawing to a close, A. Q. Khan, a Pakistani metallurgist widely believed to be the progenitor of Pakistan's nuclear bomb, gave an interview to an eminent Indian journalist, Kuldip Nayar. In this interview, Khan categorically spelled out Pakistan's ability to manufacture a nuclear weapon. He could not have given this interview without the prior knowledge and consent of the military establishment in Pakistan.

It is a matter of some debate whether Khan's statement was intended as a nuclear threat. Although his statement did not directly affect the outcome of the crisis, one can make a plausible argument that the Pakistani confirmation of its possession of nuclear weapons deterred India from pressing Pakistan further.

The Crisis of 1990

The nuclear aspect of the 1987 crisis may appear somewhat murky. The next crisis, that of 1990, had a more clear-cut nuclear dimension.[10] In 1989, a full-scale insurgency broke out in the Indian state of Jammu and Kashmir, the origins of which were rooted in decades of Indian misrule. Once again, Pakistan's support for the insurgents greatly expanded the scope of the uprising.[11] Unlike the 1987 crisis, the precise features of the 1990 crisis remain unclear. What is widely believed, however, is that in early 1990, India, exasperated with Pakistan's support for the insurgents, started to strike at training camps for the Kashmiri insurgents within Pakistani territory. By March–April 1990, Pakistani intelligence agencies picked up signs of what they construed to be an impending Indian attack. Accordingly, Pakistani forces started preparations for war, the most important step for which—given Pakistan's significant conventional inferiority—was the handing down of orders to arm the F-16s with nuclear weapons.[12]

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[10]For thoughtful descriptions and analyses of the 1990 crisis, see Stephen P. Cohen, "1990: South Asia's Useful Nuclear Crisis," paper presented to the Annual Meeting of the American Association for the Advancement of Science, Chicago, Illinois, 6–7 February 1992; and Devin T. Hagerty, "The Power of Suggestion: Opaque Proliferation, Existential Deterrence, and the South Asian Nuclear Arms Competition," *Security Studies*, Vol. 2, Nos. 3/4 (Spring–Summer 1993).

[11]For a detailed analysis of the origins of the insurgency, see Sumit Ganguly and Kanti Bajpai, "India and the Crisis in Kashmir," *Asian Survey*, Vol. 92, No. 578 (May 1994).

[12]Hagerty, 1993, "The Power of Suggestion," p. 276.

American intelligence sources picked up these developments in both India and Pakistan. Accordingly, then-Deputy National Security Adviser Robert Gates flew to Islamabad and New Delhi to urge restraint. Whether the Gates mission made any difference in de-escalating the crisis is the subject of some debate.[13] Clearly, it did no harm.

In the absence of more detailed information, it is impossible to conclusively demonstrate that the incipient nuclearization of the region enabled India and Pakistan to step away from the brink. Nevertheless, it is certainly plausible that the knowledge of the mutual possession of nuclear weapons acted as an important brake on conflict escalation.

One possible and important criticism of the Indo-Pakistani deterrent relationship must be addressed. This relationship has a somewhat tenuous quality, given the weakness of C^3I and the possibilities of misperception and inadvertence. Furthermore, in the past, deterrence has failed in South Asia.[14] Consequently, despite the absence of any intent to initiate conflict, conflict may nevertheless ensue through a combination of technical failure and human error.

Intrastate Threats

The incipient nuclearization of the region has rendered direct interstate conflict increasingly unlikely. The more immediate threats stem from domestic turmoil and its spillover effects. What, then, are the principal sources of internal conflict in the region? The long list includes the decay of political institutions in both India and Pakistan; the dramatic expansion of political demands, principally in India; the rise of ethnoreligious fervor; and the competition for scarce resources. In addition, the cheapness and easy availability of small arms throughout the region have greatly enhanced both the possibility and the incidence of violence.[15]

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[13]Cohen, "The 1990 Nuclear Crisis," p. 9.

[14]See Robert Jervis, Richard Ned Lebow, Janice Gross Stein, et al., Eds., *Psychology and Deterrence* (Baltimore: The Johns Hopkins University Press, 1984). For a discussion of deterrence failure in the South Asian context, see Sumit Ganguly, "Deterrence Failure Revisited: The Indo-Pakistani Conflict of 1965," *The Journal of Strategic Studies*, Vol. 13, No. 4 (December 1990), pp. 77–93.

[15]For a flawed but useful attempt to discuss the implications of the spread of small arms in the region, see Chris Smith, *The Diffusion of Small Arms and Light Weapons in Pakistan and Northern India* (London: The Centre for Defence Studies, 1993).

The Punjab and Kashmir

Institutional decay coupled with increased political mobilization is the principal cause of two major conflicts in India: those in Punjab and Kashmir. The regime of Indira Gandhi steadily centralized political authority and degraded India's secular and federal institutions.[16] Her son and successor, Rajiv Gandhi, did little to stem this process of institutional decline. If anything, he further raveled the nation's secular fabric with his thinly veiled sectarian appeals.

This institutional decay took place against a backdrop of increasing political mobilization. The increasing levels of literacy, voter participation, and exposure to mass media combined with Indira Gandhi's populist policies and slogans all contributed to the high levels of political mobilization. Accordingly, hitherto subdued minorities steadily became more assertive in Indian politics. The assertiveness of minority groups has, in turn, generated a backlash from the majority community, which fears an erosion of its long-entrenched privileges. This phenomenon helps to explain the rise of Hindu chauvinism and the growing popularity of the Bharatiya Janata Party (BJP). The BJP's rising popularity has been accompanied by a rise of ethnoreligious violence in India. This spate of violence reached its nadir on December 6, 1992, when members of organizations known to have close links with the BJP attacked and destroyed the Babri mosque in the state of Uttar Pradesh in northern India. The mosque was the object of Hindu wrath because it was putatively built on the ruins of a Hindu temple that consecrated the birthplace of Lord Rama, one of the principal members of the Hindu pantheon.

In the wake of this destruction, widespread rioting broke out across northern Indian and in several major metropolitan centers. The vast majority of the victims of this anarchic violence were low-caste Muslims.[17] Inevitably, the violence was not confined to India; angered by the destruction of the mosque, Muslim mobs attacked Hindu places of worship in both Pakistan and Bangladesh, often with the acquiescence of local authorities.[18]

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[16]For an excellent set of discussions of the decline of India's political institutions under Indira Gandhi, see Henry Hart, *Indira Gandhi's India: A Political System Re-Appraised* (Boulder: Westview Press, 1976). A more recent assessment is Krishna K. Tummala, "India's Federalism under Stress," *Asian Survey*, Vol. 32, No. 6 (June 1992), pp. 538–553.

[17]See, for example, P. Sainath, "Bombay Riots of December 1992: A Report," in *Communalism in India: Challenge and Response* (New Delhi: Manohar, 1994).

[18]Sumit Ganguly, "Ethno-religious Conflict in South Asia," *Survival*, Vol. 35, No. 2 (Summer 1993), pp. 88–109. See also M. K. Narayanan, *National Security: The Internal Dimension* (New Delhi: The Rajiv Gandhi Institute for Contemporary Studies, 1994).

Explanations for the recent electoral success of the BJP in the western Indian states of Gujarat and Maharashtra differ. Some analysts attribute their electoral victories to an anti-incumbent mood that appears to be sweeping the country. Others argue that the BJP's ideological position on secularism and the treatment of minorities holds considerable appeal to an increasingly frustrated Hindu middle class.[19] These debates notwithstanding, there is little question that the BJP has emerged as an important force in Indian politics.

The future of India's secular institutions and their ability to contain ethnoreligious conflict will depend greatly on the policies and programs that the BJP pursues in office and on its performance in the national elections scheduled for 1996. Any failure to maintain a secular political framework that guarantees minority rights will have significant adverse consequences for India and the region. An intolerant Hindu regime in India would consign significant minorities, particularly Muslims, to an inferior political status, which would result in further ethnoreligious discord and violence.

India has brought the Punjab to a state of near normalcy by using highly repressive tactics and holding local and state-level elections.[20] Similar tactics are unlikely to succeed in Kashmir for two reasons. First, Kashmir is the subject of an interstate dispute between India and Pakistan. Second, in the state of Jammu and Kashmir, a significant portion of the population is no longer unequivocally loyal to India. Also, since the end of the Cold War, international norms about self-determination are shifting. The international community, which at one time seemed unalterably opposed to the creation of new states, appears more willing to reexamine that principle.

Currently, India faces an ongoing insurgency in Kashmir that occupies more than 400,000 paramilitary troops and Indian Army personnel. A variety of insurgent groups—ranging from the Muslim fundamentalist, pro-Pakistani *Hizb-ul-Mujahideen* to the notionally secular Jammu and Kashmir Liberation Front (JKLF)—remain active. In recent months, the insurgency has received a boost from the entry of former Afghan guerrillas into the fray. Battle-hardened from their involvement in the decade-long struggle against Soviet occupation, the Afghan guerrillas have added a new dimension to the conflict in Kashmir. Their greater willingness to suffer casualties makes them a more formidable foe for

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[19]Yubaraj Ghimire, "The Saffron Resurgence," *India Today* (March 31, 1995), pp. 34–37.

[20]For a thoughtful analysis, see Gurharpal Singh, "The Punjab Elections 1992: Breakthrough or Breakdown?" *Asian Survey*, Vol. 33, No. 11 (November 1992), pp. 988–999.

the Indian security forces. On the other hand, their lack of regard for the local populace has also resulted in diminished popular support for their presence in Kashmir.[21] The insurgency in Kashmir has reached a stage similar to the one in Vietnam that Daniel Ellsberg referred to as the "stalemate machine."

At present, the guerrillas cannot expect to defeat the Indian security forces, nor can India prevail militarily in the foreseeable future. In any case, merely inflicting military defeat on the insurgents will not resolve the conflict. At best, a military success would provide the basis for political and diplomatic negotiations with the Kashmiri militants and Pakistan. Failure to pursue a negotiated settlement will only result in the recrudescence of political violence in the future.

India's problems are not confined to the Punjab and Kashmir. It faces continuing problems in the northeast where Naga and Kuki tribes are engaged in brutal, internecine conflict. Neophyte Maoist guerrillas continue to wreak havoc in the central Indian state of Andhra Pradesh, and the Bodo tribes continue to threaten the political stability of the state of Assam.

A combination of reform and repression will enable India to tackle and resolve most of these conflicts. The coercive powers of the Indian state, which have grown significantly in recent years, will have to be exercised with greater care, however.[22] The partisan and often brutal behavior of India's vast network of paramilitary forces has often exacerbated the very problems that they were deployed to tackle.

Pakistan's Conflicts and the Example of Sindh

Pakistan's internal conflicts, in comparison with those of India, are even more intractable and have structural roots. Since independence in 1947, Pakistan's political institutions have rarely enjoyed substantial legitimacy. The military deposed a weak government as early as 1958. Subsequently, Pakistan has enjoyed only brief periods of democratic rule. Its most recent democratic experiment started in 1988, following the abrupt death of General Zia-ul-Haq in a plane crash. Eleven years of military rule in Pakistan has left a legacy that is difficult to dismantle, however, and democratic consolidation has been slow.[23] Today, the prime minister and the president exist at the sufferance of the military.

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[21]Anthony Davis, "The Conflict in Kashmir."

[22]For a particularly incisive analysis of the growth and abuse of police and paramilitary forces in India see Kuldeep Mathur, "The State and the Use of Coercive Power in India," *Asian Survey*, Vol. 32, No. 4 (April 1992), pp. 337–349.

[23]For a particularly trenchant analysis, see Hasan-Askari Rizvi, "The Legacy of Military Rule in Pakistan," *Survival*, Vol. 31, No. 3 (May/June 1989), pp. 255–265.

Benazir Bhutto's regime, which came to power in 1992, suffers from structural weaknesses. The organizational basis of the ruling Pakistan's People's Party (PPP) remains weak and factional. It has been hitherto unable to overturn the Eighth Amendment to the Constitution, which strengthened the office of the president while weakening that of the prime minister. The shortcomings of the Bhutto regime have been particularly apparent in its inability to tackle the growing lawlessness in the city of Karachi in the province of Sindh.

The roots of the ethnic violence that has racked the province of Sindh are complex.[24] Two issues of subnationalism are significant here. In the mid-1980s, *muhajir* (Urdu-speaking Muslims who had migrated from India at the time of partition) subnationalism came to the fore in the Sindh. The MQM (muhajir Quami Mahaz), capitalizing on the grievances of the community, swept the polls in 1987 in the urban areas most densely populated by the *muhajirs.* The rise of *muhajir* subnationalism could be traced primarily to the erosion of their once-prominent socioeconomic status in the economy of urban Sindh. The emergence of Punjabi and Pakhtun traders in Sindh had contributed to the decline of the position of the *muhajirs.*

A rise of Sindhi subnationalism paralleled the rise of *muhajir* subnationalism. The Sindhis, indigenous to the region, had lost ground to the better-educated *muhajir* community since independence. Rising unemployment among educated Sindhi youth, poor representation in the higher echelons of the Pakistani Army, and the execution of Zulfiquar Ali Bhutto all fueled Sindhi resentment against the *muhajirs* as well as the Punjabis.

Since the end of military rule, the *muhajir*–Sindhi conflict has spilled onto the streets of urban Sindh principally in the capital city of Karachi. The rising violence in Sindh during the past several years has been fueled by large quantities of small arms that have been brought into the province at the end of the Afghan war. The drug trade that flourished during the Afghan conflict was partly responsible for creating this arms pipeline to the Sindh. Also, the weakness of local authority has allowed the growth of condotierri, who can act with impunity in the region. The March 1995 killings of two American consular employees in Karachi exemplified the breakdown of legally constituted authority in much of Karachi.

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[24]For a careful analysis of the origins of the problem and the military's role in exacerbating it, see Samina Ahmed, "The Military and Ethnic Politics in Sindh," in Rasul B. Rais and Charles H. Kennedy, Eds., *Pakistan Briefing,* 1994 (Boulder: Westview, 1995).

No easy solution exists for Pakistan's deep-seated problems of governance. Unless its leadership can strengthen the existing institutions both at local and national levels, the state's writ will increasingly diminish. This steady erosion of state authority and the rise of anarchic violence bode ill for both Pakistan and the region.

Conclusions

The incipient nuclearization of the region has limited the prospects of direct, interstate war. The principal dispute in the region, the Indo-Pakistani conflict, is unlikely to spawn yet another full-scale war. Nevertheless, the region remains conflict-ridden.

The emergent security issues in the region require different responses at the international and regional levels. To begin with, the conflicts in the region do not immediately affect the interests of any of the major powers; the United States, the only genuinely global power, has distinctly limited interests in South Asia.

The internal nature of South Asian conflicts limits the options available to the international community. Interstate conflicts are more amenable to external sanctions, embargoes, and other pressures than are internal conflicts. Until recently, the norm of sovereignty precluded most forms of external pressure against the domestic behavior of states. This principle is slowly undergoing a change, and the international community may adopt more intrusive procedures to thwart internal conflicts. The greater emphasis on maintaining minimal standards of human rights is a step in that direction.

At a regional level, the two principal powers in South Asia, India and Pakistan, must learn to resist the temptation to escalate internal conflicts. Although both sides view the risks as controllable and calculable, the 1987 and 1990 episodes suggest otherwise.

3

Misconceptions about the Cooperative Threat Reduction Program

*Richard S. Soll**

The Cooperative Threat Reduction (CTR) program has had significant impact on US security policy toward the newly independent states (NIS) of the former Soviet Union and on US arms reduction and nonproliferation interests. The continued funding and vitality of the program is threatened by misconceptions that cast doubt on the program's efficiency and effectiveness. The purpose of this paper is to recount some of the most prevalent misconceptions about the CTR program, describe the framework in which they have emerged and spread, and debunk them—or provide alternative arguments—in light of the public record.

Background

The political and economic conditions that attended the disintegration of the Soviet Union at the end of 1991 called into question the Soviet ability to maintain effective control over its arsenal of nuclear and other weapons of mass destruction (WMD) and to prevent their proliferation. Since then, these conditions have not disappeared and, in many cases, have worsened. The ability of the NIS to accelerate or even fulfill their arms reduction and arms elimination commitments, in the face of worsening and uncertain economic conditions, is doubtful unless continued assistance is provided. It is this environment that gave rise to the Nunn–Lugar initiative in Congress and the associated CTR program.[1]

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[1]Basic information on the CTR program has been derived from a number of public sources, including Department of Defense, *Second FY 1994 Semi-Annual Report on Program Activities to Facilitate Weapons Destruction and Nonproliferation in the Former Soviet Union*, October 30, 1994; Theodor Galdi, *The Nunn–Lugar Cooperative Threat Reduction Program for*

The US Department of Defense (DoD) provides equipment, services, and technical advice through the CTR program to Russia, Belarus, Kazakhstan, and Ukraine. This assistance is given to eliminate (or in the case of Russia, to reduce) the WMD remaining from the Soviet era and to dismantle the associated infrastructure and/or transform portions of it into peaceful assets. In each fiscal year from 1992 through 1995, Congress has provided, by means of reprogramming authority or direct appropriation, $400 million to DoD for CTR assistance. As required by the legislation, US businesses, expertise, and technology are being used to the extent feasible.

Thus far, the United States and the recipient countries have entered into 36 bilateral implementing agreements. The projects conducted pursuant to these agreements are directed toward facilitating the reduction of Russia's strategic offensive arms; the complete denuclearization of Belarus, Kazakhstan, and Ukraine; safe and secure transport and storage of nuclear warheads and fissile materials in Russia in connection with warhead dismantlement activities; elimination of Russian chemical stocks in accordance with Russia's commitments under the Chemical Weapons Convention; and various demilitarization activities to promote defense conversion and enhanced military-to-military contacts in all four states.

The CTR program helps to ensure that nuclear weapons and other WMD will not be subject to diminished custody, control, or safeguards and that nuclear weapons, materials, and expertise will not become proliferated commodities. In addition, CTR assistance is supporting the former Soviet states in meeting and even accelerating their obligations to the Strategic Arms Reduction Treaty (START) and, in the case of Russia, the Chemical Weapons Convention.

According to Secretary of Defense William J. Perry,[2] by early 1995 CTR had contributed to the removal of more than 2500 warheads from missile and bomber bases into secure central storage in Russia; the return to Russia of over 1000 warheads that were located in Belarus, Ukraine, and Kazakhstan; the deactivation of four regiments of SS-19 intercontinental ballistic missiles (ICBMs) in Ukraine; the removal of

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Soviet Weapons Dismantlement: Background and Implementation, 93-1057 (Washington: Congressional Research Service, Library of Congress, December 29, 1993); Major General (Retired) Roland Lajoie, Director of the CTR Program Office, briefing to Defense Nuclear Agency Forecast to Industry, Arlington, Virginia, November 8, 1994; Secretary of Defense William J. Perry, *Annual Report to the President and the Congress* (Washington: Government Printing Office, February 1995); and the pertinent legislative record and legislation.

[2]William J. Perry, "Remarks Prepared for Delivery at the National Press Club, January 5, 1995," News Release No. 007-95 (Washington: Office of the Assistant Secretary of Defense for Public Affairs), pp. 3–5.

750 missiles from their launchers and elimination of approximately 575 launchers and bombers throughout the former Soviet Union; and the employment of more than 5000 weapon scientists and engineers on peaceful, civilian research projects to prevent their exacerbating global WMD proliferation. The Project Sapphire mission in November 1994 to remove several hundred kilograms of highly enriched uranium to the United States from poorly secured storage in Kazakhstan was partly funded by CTR and, according to Secretary Perry, without US–Kazakhstani cooperation on CTR projects, "we might never even have known about this material."[3]

Of the $1.27 billion available under the CTR program—the authorized amount minus fiscal year 1992 and 1993 expired authority—projects comprising about $1.2 billion have been proposed to be obligated in notifications to Congress. Approximately half of the latter amount has been obligated and an even smaller amount actually disbursed, leading to perceptions that the program has floundered, while squandering precious funds.

Misconceptions about CTR

1. *CTR is just foreign aid under a different name.* Although foreign aid has always been controversial, it has become the target of growing scrutiny and scorn in the post-Cold War era.[4] Aid to Russia has been singled out for special inquiry and criticism because events in Chechnya and other Russian policies suggest to many Americans that the NIS are turning away from reform. According to Senator Richard Lugar (R-IN), the Chechnya war is ruining the Russian economy, and "just putting in good money after bad wouldn't make sense."[5] Aid to the NIS has been called "a $3 billion hobby shop" by one observer,[6] who includes the CTR program prominently in this characterization.

Lugar, however, is quick to distinguish between economic aid to Russia and funding for the CTR program, of which he is a co-author with Senator Sam Nunn (D-GA). Department of Defense officials also point out that while foreign aid for the NIS is intended to improve those

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[3]Ibid., p. 4.

[4]See, for example, Editorial, "The Real Foreign Aid Debate," *The Washington Post*, February 18, 1995, p. A20; Steven Greenhouse, "In New Political Climate, Saving US Foreign Aid Isn't Easy, "*The New York Times*, February 19, 1995, p. I-18.

[5]Thomas W. Lippman, "GOP Tempo Differs on Foreign Policy," *The Washington Post*, January 18, 1995, p. A4.

[6]Charles Flickner, "The Russian Aid Mess," *The National Interest*, No. 38 (Winter 1994/1995), p. 13.

countries' economies, help their transition to democratic societies, and provide humanitarian assistance, CTR adheres to its original threat reduction goals; thus, it is called "defense by other means."[7] According to Lugar, CTR assistance "will have to continue if we are serious about moving ahead to destroy the potential to attack us."[8]

CTR projects that are not directed toward eliminating deployed weapons per se—in particular, defense conversion and NIS missile officer housing efforts—have been highlighted as being too similar to foreign aid. A corollary criticism is that these projects do not contribute directly to US defense requirements and, therefore, are not a legitimate use of defense funds.

In response to such criticisms, Defense Secretary Perry has stated that "destroying weapons is not enough. To do the job right we must deal with the vast Soviet nuclear-weapons complex behind every weapon."[9] The Secretary of Defense describes the conversion efforts as win-win-win: They help reduce the threats from WMD; they help the NIS build peaceful, commercially viable market economies while reducing excess military capacity; and they provide opportunities for US industry into potentially large markets for civilian goods and services.[10] Despite attempts by DoD officials to draw these infrastructure projects into the innermost circle of core CTR threat reduction efforts, their future funding and existence are in doubt.

2. *The CTR program has departed from its original objective of dismantling former Soviet nuclear and chemical warheads.* The claim has been made that no nuclear warheads or chemical weapons have been dismantled in Russia under the American aid program.[11] In fact, however, the original Nunn–Lugar legislation, passed at the end of 1991, never identified warhead dismantlement as an explicit activity in which the United States would become involved directly. Instead, CTR assistance was intended to "facilitate, on a priority basis, the transportation, storage, safeguarding, and destruction, of nuclear and other weapons in the Soviet Union."[12] The program was known in its early days as the Safety, Security, and Dismantlement (SSD) program, thus adding to the misconception that hands-on dismantlement was the crux of the endeavor.

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[7]William J. Perry, "Remarks Prepared for Delivery to the Henry L. Stimson Center, September 20, 1994," News Release No. 535-94 (Washington: Office of the Assistant Secretary of Defense for Public Affairs, September 20, 1994), p. 4.

[8]Lippman, p. A4.

[9]Perry, National Press Club address, p. 4.

[10]Ibid., p. 6.

[11]Flickner, p. 15.

[12]US Public Law 102-228/Title II, signed into law December 12, 1991.

Throughout the early discussions with US officials on nuclear weapons safety, security, and dismantlement, Russian officials consistently emphasized that Russia neither needed nor wanted a direct US role in the warhead dismantlement process.[13] They identified, instead, various deficiencies associated with transportation and storage that limited the pace of dismantlement, and they requested specific items of assistance to address those deficiencies. These requests included enhancements to nuclear weapons rail cars; provision of fissile material storage containers; design, equipment, and construction assistance for a facility in which to store, on a long-term basis, fissile material removed from dismantled warheads; armored blankets for protecting warheads in transit in connection with their dismantlement; and nuclear emergency response equipment and training. In addition, $385 million of the CTR funds proposed to be obligated in notifications to Congress are earmarked specifically for NIS strategic offensive arms elimination, that is, for equipment and services to destroy ICBMs and launchers (including silos), heavy bombers, and strategic missile-carrying submarines, but not warheads.

Nevertheless, a nagging criticism of the CTR program has been its failure to get inside Russian nuclear warhead dismantlement facilities, leading to the conclusion that the program has failed to live up to its promise. Assistant Secretary of Defense Ashton B. Carter noted in February 1995 that "we are not dismantling nuclear warheads themselves" because the Russians have not accepted offers of help in that area. According to Carter, "we are dismantling airplanes, missiles, silos, industries and submarines, all of which were designed to destroy the United States."[14]

3. *Some CTR projects are directed toward improving the quality of life in the former Soviet Union with funds that could be used to improve the quality of life for Americans.* This misconception is related to the first one concerning CTR as foreign aid, but it is targeted mainly at projects for providing housing for demobilized NIS missile officers and at efforts for employing and redirecting NIS weapons scientists and engineers.

The missile officers who maintain, safeguard, and, if need be, launch the nuclear forces cannot be demobilized, under the laws of the NIS, unless adequate housing is provided. Thus, the officer housing projects are deemed a necessary element of CTR efforts to assist the NIS in eliminating or reducing their strategic offensive arms.

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[13]Sam Nunn and Richard Lugar, *US–Russian Relations after the Russian Elections: Trip Report*, Washington, January 10, 1994, p. 4.

[14]Quoted in Fred Hiatt, "Paying Russia to Destroy Nuclear Weapons: Critics Call Program a Dud," *The Washington Post*, February 12, 1995, p. A36.

The case of Ukraine illustrates the scope of the strategic nuclear arms elimination task and the associated requirements. Under Ukraine's current schedule, SS-19 ICBMs and their silos will be completely eliminated by the end of 2001; CTR assistance is intended to accelerate this schedule by three years. However, Ukrainian law (like Russian and Belarusian law) prohibits the demobilization of officers unless adequate housing is available. Given the severe housing shortage in Ukraine and throughout the NIS, owing to overall economic hardship, Ukraine will not be able to house demobilized officers and thus will not support any shortened time lines without US assistance.

According to Secretary Perry, "we want these officers to retire. We certainly don't want a corps of disgruntled nuclear weapons officers at loose ends."[15] Perry recounts a December 1994 meeting with a group of freshmen House Republicans in which he was asked, "Why are we spending money on quality of life for former Soviet troops when we should be worried about American troops?" His reply was, "We're not helping to build housing for Soviet missile officers to improve their quality of life; we're doing it to improve our quality of life" by eliminating nuclear weapons that threaten the United States.[16]

Similar questions abound concerning the science and technology center established in Moscow under CTR. This center employs in civilian endeavors Russian scientists and engineers who were traditionally engaged in work related to weapons of mass destruction; similar centers are planned for Belarus, Kazakhstan, and Ukraine. As noted above, the centers in Moscow and Kiev will help to employ more than 4000 scientists and engineers in nonweapons research projects. In Perry's words, "this way, they're less likely to wind up working on a nuclear bomb program in Libya or Iraq or Iran."[17]

In summary, these projects, while appearing to be designed to improve the quality of life in the NIS, are regarded by DoD as central to the goal of removing, as Perry says, "the threat, missile by missile, warhead by warhead, factory by factory, and person by person."[18]

4. *The US contracting process is a major cause of delays in implementing CTR projects.* During the first two years of its existence, the CTR program was slow in producing results; so slow, in fact, that Secretary Perry stated in 1994, "I'm personally disappointed that it took this administration so much time to get it [i.e., CTR] moving."[19] Although much of the finger-pointing has been in the direction of the program's implementors

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[15]Perry, National Press Club address, p. 5.
[16]Ibid.
[17]Ibid., pp. 4–5.
[18]Ibid., p. 2.

in DoD, even the General Accounting Office correctly attributed the delays mainly to "the time needed to complete agreements between the United States and the former Soviet republics, fully develop projects, and comply with legislated requirements for reallocating funds originally appropriated for non-CTR purposes."[20] Other criticisms concerning the program's perceived slowness stem from the frustration, addressed above, that nuclear warheads have not been dismantled as a direct result of CTR assistance.

The contracting process is necessarily lengthy. It involves reaching agreement on specific requirements and technical specifications with the United States' bilateral partners, defining the types of equipment and services that would have to be provided under CTR, and soliciting bids from industry. The NIS recipients are, as their collective name suggests, new states. They are still turbulent politically, and their emerging bureaucracies have not yet settled upon the best division of labor or ways of operating efficiently in the post-Soviet environment.

In addition to bureaucratic problems, sensitivities about disclosing details of weapon-related systems, facilities, and procedures only a few years after the end of the Cold War place major constraints on the disclosures necessary for specifying requirements. For example, although an agreement was signed in September 1993 between the US and Russian governments to provide equipment for a long-term storage facility for fissile materials from dismantled warheads, the Russians—despite constant prodding by the United States—failed to deliver the list of required equipment until January 1994. As a result, DoD was unable to issue requests for proposals (RFPs) for US businesses to procure and ship the required items in time for a spring or summer construction start on the storage facility.[21] Another example concerns the attempts to implement the strategic offensive arms elimination project with Kazakhstan: Plans calling for a US integrating contractor to accomplish the destruction of SS-18 ICBM silos were put on hold when the Russians, laying claim to the silos, denied access to US government and private sector personnel in order to protect what they considered to be sensitive silo design information. These cases are typical of the projects that have undergone delays in execution, not to mention those in which political sensitivities

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[19]Perry, Stimson Center address, p. 5.

[20]General Accounting Office, *Weapons of Mass Destruction: Reducing the Threat from the Former Soviet Union*, GAO / NSIAD-95-7 (Washington: GAO, October 1994), p. 2.

[21]Harold P. Smith, Jr., Assistant to the Secretary of Defense (Atomic Energy), "Statement before the House Appropriations Committee, Subcommittee on Defense, on Cooperative Threat Reduction, March 9, 1994," from prepared statement submitted for the record, pp. 14–15.

or controversies have led to the failure even to secure an implementing agreement.

Despite these obvious and not unexpected causes for delay, the US contracting process is often blamed. The process has been criticized by US industry owing to frustration that CTR has not been the gold mine that was anticipated at the program's inception.[22] Indeed, it is somewhat time-consuming because, under the Federal Acquisition Regulations (FAR) and various laws, "fair and open competition" is required. Procurements must be announced widely to industry for bidding opportunities, and source selection must be conducted under rigorous procedures that are defensible as unbiased. As the Assistant Secretary in DoD who runs the policy side of the program testified in 1993, "we open to free and open competition among American contractors the contracts to carry out that assistance . . . and that takes some time."[23]

In actuality, the record of contracting is not bad. DoD public affairs releases show that a typical CTR project's initiation—from signing of a bilateral implementing agreement to initiation of work by a contractor—takes about a year. Most of that time, about two-thirds, is consumed by the bilateral, US–NIS process of defining requirements as described above. The contracting process after the requirements definition, including public announcements soliciting interested sources, RFP issuance, proposal preparation and submission, source selection, contract award, and initiation of work, has generally taken about four months, or only one-third of the typical cycle.[24]

5. *By providing assistance in certain areas, CTR affords Russia the opportunity to build its military power in other, more critical areas by helping to offset the costs.* Of the misconceptions about the CTR program addressed in this paper, this one is the most difficult to debunk, because it deals with the least tangible issues and is woven in the shadow of a Soviet Union that practiced strategic deception and seemingly unchecked military growth for many years. Furthermore, doubts about Boris Yeltsin's motives and even his knowledge and control of events, particularly where the military is concerned, continue to be raised. Despite these reservations, the following arguments bear on assessments of whether the CTR assistance offsets Russia's military budget.

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[22]According to an article in *Aviation Week & Space Technology* (August 22, 1994, p. 38), representatives from US industry place the blame for slowness in CTR acquisitions on "hard-boiled bureaucrats" in DoD.

[23]Ashton B. Carter, "Testimony before the House Foreign Affairs Committee Hearing on US Aid to the Republics of the Former Soviet Union," Washington, September 21, 1993, Reuter transcript, pp. 38–39.

[24]Smith, p. 15.

The CTR program was a direct response to the threats to US security posed by the disintegrating Soviet Union. The program directly addresses the threats posed by uncertain custody and control of weapons of mass destruction. Therefore, even if Russia becomes less stable, less open, and less democratic, the rationale remains for CTR to continue for as long as the Russian leadership is interested in cooperative engagements. Moreover, if the questionable execution and conduct and the manifestly low morale by the Russian military in Chechnya indicate an erosion of command and control, or outright military incompetence, then the imperative to reduce the former Soviet arsenal as soon as possible is strengthened.

The specific controversy over the fungibility of assistance—that is, whether CTR assistance is simply allowing the Russians to divert more of their scarce resources to modernizing their nuclear forces, thus further threatening the United States—fails to recognize, first, that neither the United States nor Russia has agreed to eliminate all of its nuclear weapons. The goal of the START treaties is to enhance strategic stability by achieving reduced nuclear arsenals that neither allow for nor encourage a first-strike capability, nor weaken deterrence against other potential hostile nations. That CTR assistance can help to accelerate Russia's compliance with START is unquestioned; using CTR-supplied equipment, Russia already is dismantling missiles, silos, bombers, and submarines.

Second, the alternative to widening and opening economic relations is to move toward isolating Russia. Isolation would most likely engender an antagonistic Russian foreign policy toward the West and thus would nullify trends in Russia toward overall transparency and accountability. Planned CTR projects that will enhance the transparency and accountability of Russian warhead dismantlement and fissile material disposition would likewise be jeopardized.

A third argument focuses on the level of effort for building relative to that for destroying an arsenal: The entire CTR strategic offensive arms elimination project with Russia agreed upon to date represents $130 million of assistance. Although that amount can go very far in providing equipment for removing and cutting up missiles, submarines, and bombers, it is insignificant in the context of developing and building a modernized Russian strategic force. Therefore, it is very unlikely that CTR assistance to Russia could free up sufficient resources to make a significant difference in the strategic balance.

Finally, it is assumed that the United States will maintain its national intelligence and reconnaissance capabilities and thus maintain vigilance against violations of arms control agreements. The lower total force levels, agreed upon and projected, demand that the United States retain

stringent verification means and measures. The CTR program places personnel and contractors on the ground, observing activities tied to weapon system elimination. In the final analysis, the fact that US CTR implementors are developing integrated programs with their NIS counterparts ensures enhanced transparency and an improved US capacity to deal with the current and projected security environment.

Secretary Perry points out that while critics in the United States charge that defense conversion programs are designed to sustain Russian defense industry, critics in Russia charge that these same conversion programs are designed to cripple the Russian defense industry. Perry observes that "both sets of critics cannot be right. In fact, neither is right."[25] Nevertheless, the residue of mistrust on both sides from decades of ideological antagonism and strategic competition will continue to gnaw at the CTR program and create the conditions in which self-fulfilling prophecies are made.

Conclusion

The five misconceptions about the Cooperative Threat Reduction Program recounted and assessed above are the ones that have made the rounds most frequently and have most threatened to undermine support for the program in Congress and the influential US business community. As evidenced in public statements and congressional testimony by the Secretary of Defense and other key officials of the Clinton Administration, a great deal of energy has been spent attempting to dispel them.

[25]Perry, National Press Club address, p. 6.

4

Solving the Proliferation Puzzle: The Role of Theory in Nonproliferation Analysis

*Zachary S. Davis**

Introduction: Why Theory?

Policymakers too often view theory the way most people look at the stars: The stars are interesting but too far away to have any relevance in daily life. The task of analyzing proliferation confronts us with an unwieldy constellation of facts, assumptions, and assertions. How do we make sense of information from sources as varied as nuclear engineering, political science, international business, intelligence, and the media? To organize information to make it useful for policymakers, we need a theoretical perspective. Political scientist Alexander George compared the use of theory by policymakers to doctors who must first diagnose a problem before treating it.[1] A theoretical perspective offers plausible explanations for specific cases of proliferation without losing sight of the global proliferation picture. One of the analyst's greatest challenges is to convey the right mix of general conceptual knowledge and case-specific information to policymakers. With this purpose in mind, policy analysts are primarily interested in policy-relevant theory, not the pursuit of pure knowledge. Policy-relevant theory serves an important role by identifying the fundamental principles underlying a phenomena such as proliferation and suggesting relationships among those principles.

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[1]Alexander George, *Bridging the Gap: Theory and Practice in Foreign Policy* (Washington DC: US Institute of Peace, 1993), pp. xx, 13.

Understanding the mechanics of proliferation—and nonproliferation—prepares policymakers to set priorities and design strategies with an awareness of the likely consequences of their actions.

At least three reasons can be given for analysts to include theoretical perspectives when reporting to policymakers. First, it is utilitarian. We must organize our search for relevant information lest we make the mistake of the drunkard, who searches for his lost keys under the lamppost because that is where there is light. A conceptual framework guides a systematic search and allows us to set priorities for what to look for and where to find it. Such a framework can ameliorate the tendency to base proliferation analysis on prior experiences, which may help to avoid surprises such as Iraq's calutrons. Second, we must organize the knowledge we collect to convey it to consumers in the policy realm. A random collection of facts and speculation is of little use to overburdened officials. Theorists should select and consolidate information to facilitate the economic use of time and effort. Third, underlying assumptions about proliferation and world politics already shape the thinking of policymakers and analysts alike, whether they acknowledge it or not. These hidden assumptions should be examined. It is impossible to divorce theory from policy because theorems, worldviews, and personal experiences are already ingrained in the thinking of decisionmakers. Analysts provide a service by bringing these underlying assumptions to light.

As proliferation has taken center stage in post-Cold War US foreign and security policy, underlying assumptions are being reexamined. Top government officials routinely cite nuclear proliferation as "the principal threat to the security of the United States and the international community."[2] However, behind these statements is an uncertainty about the nature of the proliferation threat. Is the world heading toward global nuclear chaos or perpetual nuclear peace? Will there be a new surge of proliferation in the post-Cold War era, or will nuclear weapons eventually become obsolete? And most importantly, how does proliferation threaten US security? To answer such questions, we must develop policy-relevant theories of proliferation that incorporate insights from international relations theory, war studies, technology, history, psychology, sociology, and the physical sciences. However, where purely academic theory requires making choices between causal factors to isolate and verify independent and dependent variables, the policy-oriented analyst has more freedom to speculate about alternative explanations. In fact, policymakers usually demand such alternatives. Moreover, where pure

[2]Secretary of State Warren Christopher, announcing US positive security assurances, April 6, 1995.

theory can ignore consequences, policy-relevant theory must be guided by them. Given the different demands on academicians and policymakers, how can the analyst use theory to serve the policy community?

Building Proliferation Theories

A policy-relevant conceptual model can identify the most salient causal factors and organize them to help us estimate the relative influences of particular variables in specific cases. It is not necessary for the policy analyst to operationalize the variables to make an awareness of them valuable. For example, internal factors such as political leadership, culture, and history may dominate nuclear decision-making in some cases, but external factors such as regional threats and global interests may have more influence in others. Without claiming to have predictive capabilities, a working model that identifies the most influential factors in nuclear decision-making helps policymakers to focus on policy options that offer a reasonable chance of producing preferred outcomes—as well as avoiding counterproductive actions.

The first step in building proliferation theory is to gather information on the capabilities and intentions of the countries to be examined. Typically, this includes existing capabilities, procurement patterns, force structure, alliances, plans, training, exercises, leadership, and publicly and privately stated intentions. In its raw form, such unprocessed intelligence can do more harm than good for policymakers who rely on analysts to highlight significant trends and developments. An organizational framework, such as that developed by Kenneth Waltz in his first book, *Man, the State and War*,[3] helps to make this information accessible. Waltz divides the causes of international war into three categories: individuals, nation-states, and the anarchic international system. Let us examine the relevance of each category for proliferation.

Human Factors

The actions of particular individuals have often been pivotal for national nuclear policies. We need only recall the contributions of scientists and leaders such as Robert Oppenheimer, Andrei Sakharov, Homi Bhabha, and Munir Khan, and other key personalities to their nation's nuclear programs. Studies of influential personalities can provide many insights into the inner workings of national nuclear policy.

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[3]Kenneth Waltz, *Man, the State and War* (New York: Columbia University Press, 1954).

National Characteristics

Another major category of causal factors for proliferation stems from the internal characteristics of particular countries. Included in this category are studies of comparative government, leadership, institutions, bureaucracies, decision-making processes, legal systems, history, and culture. The trend in academic circles to view politics, including nuclear weapons issues, through the lens of social construction theory fits into this category as well. The popular term "rogue nation" is also a typology of national character. An awareness of national factors is particularly relevant for specially tailored, regional approaches to proliferation, as specified in current policy.[4] Because countries vary so widely in their approaches to security and nuclear weapons, it is essential to take into account the internal factors that motivate them to acquire nuclear capabilities.

National factors can also contribute to an assessment of how power is used by its possessors. Some countries are content with the status quo, while others seek to alter the international order. Some seek power sufficient for their defense, while others harbor aggressive designs. Some are guided by messianic ideology, while others are more pragmatic. Countries also vary in their attitudes toward violating norms against acquiring weapons of mass destruction, making nuclear threats, and using nuclear weapons.

The Anarchic International System

For many analysts, policymakers, and scholars, global anarchy is the main driving force behind international behavior, including proliferation. States are motivated by survival, which can be assured only through independent means or alliances with other states. Thus, countries facing threats either need nuclear weapons to guarantee their sovereignty or credible commitments from other countries to protect their security.

Some, including Professor Waltz, believe that the nuclear deterrence relationship that existed between the United States and the Soviet Union during the Cold War can be duplicated elsewhere. From this perspective, nuclear proliferation has an overall positive effect on international

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[4]"The proliferation problem is global, but we must tailor our approaches to specific regional contexts." *A National Security Strategy of Enlargement and Engagement*, the White House, February 1995, p. 14; Lynn Davis, Under Secretary of State for Arms Control and International Security Affairs, "Preventing the Proliferation of Dangerous Arms," address before the Atlantic Council, Washington DC, December 8, 1994: "We tailor our policies to the security, economic, and political situation of each country."

security and, therefore, should not be viewed as a threat. Thus, efforts to halt proliferation are viewed as misguided. Others, however, dispute this logic. They believe that the US–Soviet deterrent relationship was not always reliable, especially during times of crisis.[5] Furthermore, even if deterrence between Washington and Moscow did reduce the risk of war between the superpowers, there are reasons to question whether such stability can be recreated under different regional and national circumstances. Evolving deterrence dyads and triads are more likely than not to encounter their own crises on their way to maturity. From this perspective, a complicated global network of deterrence relationships holds many opportunities for failure and increases the risk of nuclear war.

System-level analysis exposes several fundamental assumptions about proliferation. First, proliferation—like war—is likely to continue as long as the use of force is the final arbiter of international conflict. A second set of assumptions holds that proliferation can cause radical shifts in the distribution of power, and that such shifts can reshape alliances, erode collective security arrangements, and stifle power projection options. Even these assumptions, which have guided US policy since the Manhattan Project, however, only tell part of the story.

Beyond the Three-Level Framework: Technology as a Variable

Waltz's three-level framework must be modified to accommodate all of the variables that contribute to proliferation. One such variable that has a special place in proliferation theory is technology. A political decision to acquire nuclear weapons triggers a series of technical decisions that determine the scope, timing, and character of a bomb project. Technical decisions regarding nuclear weapons acquisition can offer many insights into effective policy responses. For example, decisions about such factors as whether to acquire uranium or plutonium (or both), weaponization options, size and disposition of arsenal, deployment modes and timetables, delivery systems, and procurement plans can indicate strengths and weaknesses that may favor particular nonproliferation—or counterproliferation—options.

Regimes, Norms, and Rules

Efforts to establish world order constitute another category of variables. Even those who emphasize the anarchic aspect of the international system concede that anarchy is rarely seen in its absolute form. Norms

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[5]Kenneth Waltz and critic Scott Sagan debate the effects of nuclear weapons on international security in *The Spread of Nuclear Weapons: A Debate* (New York: W.W. Norton and Company, 1995).

and rules do affect the behavior of nations, including their attitudes toward nuclear proliferation. Security-seeking states often find relative advantage in cooperation, especially as an alternative to a full-blown, Hobbesian war of all against all. Thus, there is a high degree of cooperation in maintaining nonproliferation norms, which collectively constitute the nonproliferation regime. The nonproliferation regime is the sum total of the treaties, agreements, and national policies aimed at preventing the spread of nuclear weapons.

Although there are ongoing academic debates on the character and influence of regimes in international relations, policymakers frequently use the term to describe international efforts to preserve nuclear order.[6] Some of the most important treaties and institutions which comprise that order include the Non-Proliferation Treaty (NPT), the International Atomic Energy Agency (IAEA), regional nonproliferation arrangements such as EURATOM and nuclear weapons free zones (in Latin America, the South Pacific, and being negotiated for Africa), the Nuclear Suppliers Group (NSG), and national nonproliferation export controls. These variables strongly influence the calculations of proliferators.

Armed with these causal factors, the analyst must craft concise explanations for why countries proliferate, and how proliferation affects US interests and security. Most analysts tend to emphasize particular variables. Country specialists pay special attention to internal dynamics; international relations scholars often stress the systemic factors; physical scientists tend to focus on technical factors. Despite their preferences, however, most proliferation analysts acknowledge that none of the foregoing variables is irrelevant; all have a place in proliferation theory.

Scholars who are not responsible for providing decisionmakers with actionable analysis can afford to insist on a high degree of parsimony in their theoretical explanations, even if it requires inflating the influence of a favored variable to the exclusion of others. For example, proponents of systemic causes, such as Kenneth Waltz and John Mearsheimer, are not blind to the influences of individuals and country-specific factors, but choose to inflate the role of anarchy in national security policy.[7] Others

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[6]On the uses of the term regime in nonproliferation analysis, see Zachary S. Davis, "The Realist Nuclear Regime," in Zachary Davis and Benjamin Frankel, Eds., *The Proliferation Puzzle: Why Nuclear Weapons Spread* (London: Frank Cass, 1993).

[7]For critiques of Waltz and Mearsheimer's systemic analysis of proliferation, see Daniel Deudney, "Dividing Realism: Structural Realism versus Security Materialism on Nuclear Security and Proliferation;" Glenn Chafetz, "The End of the Cold War and the Future of Nuclear Proliferation: An Alternative to the Neorealist Perspective;" and Peter Lavoy, "Nuclear Myths and the Causes of Nuclear Proliferation," in Davis and Frankel, *The Proliferation Puzzle,* op. cit.

emphasize the influence of cooperation and interdependence among nations in making nuclear weapons obsolete. Country specialists are often accused of being overly sympathetic to the countries they study, and scientists tend to focus on technological aspects. Of course, case studies can be used to demonstrate the salience of any of the foregoing variables. The analyst's challenge is to calculate the relative influences of the most important variables in a particular case and then communicate this matrix to the policymaker.

Understanding proliferation issues as they develop in particular countries is important, but it is only part of the picture. The tendency to view each case as unique detracts from the ability to maintain global nonproliferation standards. Custom-tailored approaches to proliferation problems can have unintended consequences. For example, the Agreed Framework with North Korea (which would provide new reactors to North Korea as an incentive for Pyongyang to comply with its NPT obligations) could be viewed by some as a precedent for nuclear blackmail or by others as a breech of nuclear export standards. Russian and Chinese officials have cited the North Korean deal in their rejection of US efforts to block the sale of reactors to Iran.[8] Other countries can be expected to review their own nuclear policies in light of the United States accommodating proliferation on a selective basis. Policymakers in Washington, Moscow, Beijing, and elsewhere claim their own exceptions, all of which erode the legitimacy of nonproliferation norms. As the leader of the nonproliferation regime, the United States must remember that its policies set the tone for other countries to make exceptions to the rules. It is important for analysts to include assessments of how proposed options for dealing with specific proliferators might affect the long-term prospects for proliferation.

Taking all of these factors into consideration, what does a theoretical approach tell us about the long-term prospects of proliferation? There is little evidence to suggest that proliferation will soon fade away. Without a fundamental change in the international system, countries and individuals can be expected to continue their current patterns of behavior. Until the patterns of conflict in human affairs show signs of receding, proliferation—like war—will remain a part of world politics. The rate at which proliferation occurs, however, is difficult to predict. The deterioration of global or regional security conditions could lead to further proliferation, or greatly improved security conditions could reduce interest in nuclear weapons. Some countries may follow their own logic and not

[8]R. Jeffrey Smith, "China Nuclear Deal with Iran Is Feared," *The Washington Post*, April 17, 1995, p. A1.

react to regional or global security trends. This is the background against which proliferation policy should be considered.

We should not assume that proliferation is inevitable; the rate can be controlled. To a large extent, national and international nonproliferation efforts will determine whether we face an era of nuclear anarchy or preserve a measure of world nuclear order. The future of proliferation is being decided by our responses to the tough cases we now face. Although every case of proliferation does not pose the same threat to the United States, each one has the potential to influence the future of proliferation. A theoretically informed analysis of the future of proliferation suggests that it is unwise to defer too many of today's proliferation problems lest we be faced with a backlog of problems and a deteriorating nonproliferation regime.

Putting Theory into Practice

Understanding how proliferation occurs and how it can be stopped are key ingredients for effective policy. Nonproliferation has not always been the top priority when policymakers weigh it against other economic, geopolitical, foreign policy, and domestic objectives. A conceptual picture of proliferation problems and their relationship to nonproliferation policy enables policymakers to make informed judgments about priorities, compromises, and tradeoffs among competing interests. Most policymakers want a nonproliferation strategy that is flexible enough to be compatible with other policy goals, but robust enough to ensure that US leadership can sustain and strengthen the global nonproliferation regime. Flexibility and leadership, however, are not always compatible. The following is a baseline strategy to guide efforts to balance nonproliferation with other objectives.

First, the nonproliferation regime, which is founded on the NPT, should be perpetuated by US nonproliferation policy. The NPT is the basis for international cooperation against the spread of nuclear weapons; it gives legitimacy to the nonproliferation norm and to efforts to verify and enforce nonproliferation commitments. The end of the NPT would invite a nuclear free-for-all. Accordingly, the indefinite extension of the NPT is the best way to preserve world nuclear order, although such extension will not defuse long-standing opposition to the discriminatory aspects of the treaty, which for many developing countries symbolize the unequal distribution of power in the world. Criticism of the United States' adherence with Article 4 (protecting the right of NPT parties to use nuclear technology for peaceful uses) and Article 6 (on ending

the arms race and making progress toward disarmament) persists—despite the fact that the US record on both articles is strong.

As important as the NPT is, however, its extension is not the endgame for nonproliferation. Even indefinite extension leaves the world facing a panoply of nuclear problems. More can be done to demonstrate accomplishments on Articles 4 and 6, including unparalleled technical assistance and support for IAEA peaceful use programs,[9] radical reductions in US and former Soviet arsenals, negotiations on a comprehensive test ban, negotiations on a treaty ending the production of fissile material for explosives, support for nuclear weapon free zones, and possible reductions below those specified in the Strategic Arms Reduction Treaties (START).[10] There is no substitute for sustained high-level leadership to demonstrate the US commitment to nonproliferation beyond 1995. The United States needs a post-Extension Conference strategy for preserving a wounded NPT and the world nuclear order it represents.

Second, the future of the IAEA and its safeguards system will depend on US leadership. The IAEA's 93+2 safeguard improvement plan that was prepared for the NPT Extension Conference would increase the credibility of IAEA's inspections, which was damaged in Iraq and tested in South Africa and North Korea. The 93+2 plan would assert IAEA rights to conduct timely and intrusive inspections, promote transparency in nuclear transfers, and provide the IAEA with the information it needs to detect suspicious nuclear activities.[11] High-level political support and adequate resources would go a long way toward upgrading the IAEA's ability to verify that nonproliferation obligations are being kept.

Third, export controls remain an important element of world nuclear order. They are necessary to implement NPT commitments on not contributing to nuclear proliferation.[12] The Nuclear Suppliers Group has

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[9]*NPT Article IV: The Human Dimension*, Arms Control and Disarmament Agency, January 1995.

[10]A comprehensive plan for post-Cold War nuclear order was proposed by a bipartisan task force in *Nuclear Proliferation: Confronting the New Challenges*, Council on Foreign Relations Task Force on Nuclear Proliferation, 1995.

[11]Nuclear Safeguards and the International Atomic Energy Agency, Office of Technology Assessment, April 1995.

[12]Article I of the NPT commits nuclear-weapon states not to transfer to any recipient whatsoever nuclear weapons and "*not in any way* to assist, encourage, or induce any non-nuclear weapon State to manufacture or otherwise acquire nuclear weapons. . . ." Article III commits all parties to the NPT not to provide nuclear materials or equipment to produce them unless such materials are subject to IAEA safeguards. On the future of safeguards, see David Fischer, "What Happens to Safeguards If the NPT Goes?" in Joseph Pilat and Robert Pendley, Eds., *1995: A New Beginning for the NPT?* (New York: Plenum, 1995).

consolidated gains made since the Gulf War, but China is not yet a member. China's nuclear and dual-use exports could make or break the nonproliferation regime,[13] and it is not clear whether Russia is willing or able to abide by NSG controls. Moreover, national and international pressures to relax nonproliferation export controls may have doomed efforts to replace COCOM (the Coordinating Committee rules designed to prevent technology transfer to the East bloc) with a post-Cold War control system. The unraveling of export controls would increase the risk of proliferation.

Fourth, proliferation cannot be ignored where it has occurred, especially in countries that are hostile to the United States and its allies. The military component of nonproliferation, now called counterproliferation, is an essential component of national defense. The scope of US counterproliferation doctrine is still not clear (e.g., does it include Nunn–Lugar/cooperative threat reduction programs, missile defenses, nuclear deterrence, and/or new weapons?). However, the ability to respond militarily to proliferation threats can deter such threats from being made in the first place and may be necessary in certain cases where proliferation poses a direct threat to vital US interests. Nevertheless, it is important to craft counterproliferation doctrine so that it does not unnecessarily interfere with nonproliferation diplomacy.

Fifth, intelligence is essential for national and international nonproliferation efforts. Downsizing and/or restructuring the intelligence community should not reduce the priority of proliferation intelligence.

Sixth, US policy toward threshold states and advanced proliferators should not lend legitimacy to unacknowledged capabilities. The practical necessity of preventing nuclear use should not replace the emphasis on preventing acquisition. Breaking the taboo against proliferation must have a price.

Seventh, sanctions serve several useful purposes, even if they are not by themselves a solution to proliferation. Sanctions demonstrate a commitment to nonproliferation goals. They serve as a catalyst for international nonproliferation efforts and can impose substantial costs for violating nonproliferation norms.

Eighth, the United States must preserve security relationships with allies who might otherwise be tempted to seek security in nuclear weapons. Foremost among these are Japan and South Korea.

Finally, the nuclear assets of the former Soviet Union are a wild card for nonproliferation. The Nunn–Lugar cooperative threat reduction

[13]Zachary Davis, "China's Nonproliferation and Export Control Policies," *Asian Survey* (June 1995).

programs to secure fissile materials and nuclear technology directly serve US and international security.

This strategy contains the main tenants of the nonproliferation strategy that the United States has pursued for most of the nuclear age. None of them is an absolute principle, and the relationships among them are complex. Nevertheless, an awareness of the contributions made by each of these tools of nonproliferation policy is essential for policymakers when they set priorities and consider tradeoffs to deal with particular proliferation problems.

Conclusion

A theoretical approach promotes awareness of the tensions that exist between the complex phenomena of proliferation, on the one hand, and nonproliferation policies on the other. Perhaps most important for the policymaker is an appreciation of the costs and benefits of nonproliferation policy, particularly in terms of their possible effects on: (1) US security interests, including commitments to allies; (2) the future of proliferation; and (3) the future of the nonproliferation regime.

Of course, the preferred options are those that advance US security, prevent future proliferation, and strengthen the regime. The elimination of Iraq's nuclear program scored high in all three categories. Less attractive, but still acceptable, are options that protect US security, do not make future proliferation more likely, and do not erode support for the regime. Security alliances with nuclear-capable countries fall into this category. More difficult, however, are those options that advance US security in the short term, but make further proliferation likely and/or weaken support for the nonproliferation regime. Although it may be too early to know, the Agreed Framework with North Korea may fall into this category, especially if other countries use it to justify their own risky reactor sales or to question the legitimacy of the NPT. Similarly, hard currency gained from Russian nuclear assistance to Iran may not justify the long-term consequences if Iran develops nuclear weapons. Of course, the worst options are those that fail to protect US security, stimulate proliferation, and damage the regime. Arguably, turning a blind eye toward Iraq's nuclear program in the 1980s had these consequences.

The framework presented here has three main elements: the causes of proliferation, nonproliferation responses, and the relationship between proliferation and nonproliferation. Policy-relevant theory helps policymakers to weigh these considerations and to blend them with other—sometimes competing—policy considerations. Ideally, theory helps policymakers to identify objectives, define priorities, and construct strategies for achieving desired outcomes.

5

A Critique of the Fissile Materials Cutoff Proposal

*Kathleen Bailey**

In his address to the United Nations in September 1993, US President Bill Clinton proposed an international agreement to halt production of highly enriched uranium (HEU) and separated plutonium usable in nuclear explosives. That same year, the UN General Assembly passed a resolution, co-sponsored by the United States, which stated that a "nondiscriminatory, multilateral and internationally and effectively verifiable treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices would be a significant contribution to nuclear nonproliferation in all its aspects." On March 23, 1995, the Conference on Disarmament in Geneva unanimously decided to establish a committee to negotiate such a fissile materials cutoff convention. Additionally, the cutoff objective was enshrined on May 12, 1995, by the Nuclear Non-Proliferation Treaty Review Conference, which called for immediate commencement of negotiations.

The primary benefit of a fissile materials cutoff would be to place a cap on the production of fissile materials for weapons by Israel, India, and Pakistan. In general, this appears to be a worthy goal. Yet, some limitations and costs are associated with the current proposal for a cutoff. A key limitation is the current lack of verification technologies. Principal costs of a cutoff include potential damage to the Nuclear Non-Proliferation Treaty (NPT) regime, diversion of finite diplomatic energies, and high financial costs. This paper will explore these issues briefly.

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Background

The idea of restricting the production of fissile materials as an arms control measure dates from as early as 1946, when it was proposed as a means of limiting the number of nuclear weapons that could be manufactured by the declared nuclear weapons states.[1] The proposal for a cutoff has resurfaced numerous times, but it has run into political obstacles (e.g., Soviet insistence that a cutoff be coupled with total nuclear disarmament) as well as technical (e.g., concerns over non-verifiability).

A principal difference between the cutoff proposals put forward periodically for the past fifty years and that currently being advocated is that the current version is packaged as a nuclear nonproliferation measure primarily designed to place a check on the weapons programs of Israel, India, and Pakistan. US officials have publicly stated that the United States would not participate in a cutoff that does not include India and Pakistan, at a minimum.[2]

The cutoff is focused on Israel, India, and Pakistan for three reasons. First, most non-nuclear-weapons states are already committed to nonproduction of fissile materials for weapons purposes. Most nations (approximately 95% of the states represented in the United Nations) are party to the NPT, which forbids their acquisition of nuclear weapons and provides a basis for safeguards and inspections of their nuclear facilities and materials to help assure others that they are complying with the treaty. Thus, for non-nuclear weapons states party to the NPT, a cutoff is redundant.

Second, a cutoff convention is not necessary to address the fissile materials production of the nuclear weapons states. These states have large stockpiles of fissile materials and will retain sufficient quantities to maintain their nuclear weapons for as long as they deem them to be necessary for their security. The United States and Russia have already stated that they do not need more and will not produce any new fissile materials for weapons.

Third, Israel, India, and Pakistan are neither declared nuclear weapons states nor participants in the NPT. The cutoff proposal is viewed by some arms control advocates as a means of engaging these nations in a limited, palatable process of capping expansion of their nuclear weapons capabilities.

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[1]The cutoff proposal was introduced by Bernard Baruch in June 1946. He proposed that the United Nations be given managerial control over fissionable material production worldwide. See John M. Taylor, *Restricting Production as an Arms Control Measure: An Historical Overview*, Sandia National Laboratory, Albuquerque, NM, December 9, 1983.

[2]Statement by Steve Aoki of President Clinton's National Security Council Staff at a public forum sponsored by the White House Office of Science and Technology, March 30, 1995.

India and Pakistan have expressed some willingness to negotiate a cutoff, but they insist that it be nondiscriminatory, as called for in the 1993 UN General Assembly resolution. Essentially, this means that the declared nuclear weapons states must undertake the same obligations as the non-nuclear weapons states and the undeclared nuclear weapons states (e.g., whatever rules apply to India and Pakistan must also apply to the United States). Two important implications of the requirement for nondiscrimination are: (1) because the declared nuclear weapons states will keep a stockpile of fissile materials, all nations (e.g., Israel, India, and Pakistan) will be allowed to keep such stockpiles; and (2) because some nations will continue to commercially reprocess and/or enrich these materials, all nations will be allowed to do so.

A Cutoff Is Not Verifiable

The cutoff proposal calls for an effectively verifiable agreement. The definition of "effectively verifiable" is not exact but is generally held to mean that one would have a fairly high degree of certainty that cheating would be detected. Unfortunately, current technology does not enable one to detect with high confidence the clandestine production of fissile materials. There are two major problems: the potential for undeclared production facilities, and the possibility of undeclared production at declared sites.

An undeclared isotope enrichment facility can be relatively small and hidden in a facility underground, in a mountainside, or in some unexpected place. Emissions can be minimized or eliminated, depending on the level of effort and expertise of the cheater. A centrifuge enrichment facility—such as was built successfully by Pakistan and is being sought by Iran—can be built in such a way that it would be undetectable by its physical appearance externally. Similarly, a chemical enrichment system, such as that developed in the late 1970s by Asahi Chemical Corporation of Japan (ion-exchange) or a method proven by the French company, Cogema (solvent extraction), can produce ample quantities of HEU in a facility that looks no different than an ordinary chemical plant.

Usually, isotope enrichment technologies (e.g., centrifuge, laser, or chemical) are associated with efforts to obtain uranium-235, yet they may also be applied to separate plutonium-239 from reprocessed spent reactor fuel. Such activity would be relatively easy to hide successfully.[3]

[3]It would be possible for a nation or subnational group to use reactor-grade plutonium in an explosive. If high ^{239}Pu content were desired, however, several technologies exist to obtain it. For example, pure metallic plutonium can be recovered from low-exposure spent fuel using a pyrochemical process (electro-refining) in a sealed, shielded cell using a cover

A second major problem stems from the inability to distinguish production of materials for non-weapons purposes versus that for weapons. A nation that commercially reprocesses spent reactor fuel or enriches uranium for non-weapons purposes may either use that legitimate production to mask illicit production, or it may divert materials for further enrichment elsewhere. Thus, a country may continue to produce plutonium or enriched uranium, even under safeguards, with the ever-present risk that it will either divert materials or simply break safeguards and use the fissile materials for weapons when it appears in that nation's interests to do so. For example, Russia's four gaseous centrifuge facilities could be converted to HEU production. Furthermore, centrifuges or chemical exchange technology could be used to enrich reactor-grade plutonium with low risk of detection.

One could argue that effective verification is unnecessary. After all, the NPT has the same problems with verification that a fissile materials cutoff has, yet many nations have signed that treaty. The difference is that many countries signed the NPT believing it to be verifiable. International Atomic Energy Agency (IAEA) safeguards were perceived as being able to detect cheating in declared facilities, and the national technical means of countries such as the United States were seen as capable of detecting cheating in undeclared facilities. In event of the latter, the IAEA could then conduct special inspections to dispel suspicions of, or confirm, illicit activities and facilities.

Now, however, it is clear that NPT verification has serious limits. Two parties to the treaty were able to cheat despite being subject to IAEA inspections: Iraq was able to have a secret, full-scale nuclear weapons program, and North Korea secretly produced plutonium for its weapons program. Although efforts are under way to strengthen IAEA safeguards, the same problems that will confront a fissile materials cutoff stand in the way: Most importantly, there is a lack of technological tools to detect cheating with high confidence; secondarily, the IAEA is unable to conduct inspections if a nation is unwilling to allow them.[4]

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gas of pure argon. With this method, 20 kg of plutonium could be separated from 3 tons of irradiated uranium per year in a cell $60 \times 60 \times 30$ m. There would be no emissions. The Kr, Xe, and Rn gases would be cryogenically trapped from the argon atmosphere and stored in steel containers. This example was provided to the author by Melvin S. Coops of Lawrence Livermore National Laboratory.

[4]North Korea has refused to allow special inspections by the IAEA to determine how much plutonium it produced. North Korea has suffered no repercussions as a result. In fact, one could argue that its behavior has been rewarded, as shown by the willingness of the international community to provide North Korea with new reactors and other economic assistance as incentives to comply with its international legal obligations under the NPT. This case demonstrates that national sovereignty could continue to be used to shield any determined violator of the NPT or a fissile materials cutoff.

Some countries will be more concerned about the non-verifiability of a fissile materials cutoff than others. For example, verifiability is likely to be more important to non-nuclear weapons states than it is to the declared nuclear weapons states.[5] The latter nations will retain stockpiles of fissile materials for as long as they are needed. Thus, the United States will keep sufficient fissile materials as a hedge against a potential buildup of Russian or other nuclear arsenals.

Most non-nuclear weapons states have no such hedge because they either possess no fissile materials or have limited amounts. If a cutoff were in effect, any country that secretly produces fissile materials could possibly gain a substantial advantage over others. In both the Middle East and South Asia, it is critical that countries have a strong basis for believing that their neighbors are not clandestinely producing fissile materials for weapons. Given current detection technology, there is no way to provide such assurances.

A Cutoff Presents a Serious Challenge to the NPT

The cutoff agreement constitutes an arms control measure with lesser requirements than the NPT, creating a lower common denominator for the nonproliferation regime. Because the cutoff agreement, as currently envisioned, does not cover stockpiles of fissile materials already produced, it legitimizes these holdings. In the future, North Korea, for example, may see joining the cutoff as a way to opt out of the more rigorous NPT, while still portraying itself as interested in arms control. An argument likely to be used by such nations would be that they are abandoning a discriminatory treaty for an agreement that is nondiscriminatory.

The dangers presented by this new category of "weapons option states" are exacerbated by a trend in the Clinton Administration. There is some momentum behind the notion that states adhering to the cutoff should be "paid" by the United States, which would export nuclear safety and other technologies thus far denied them because they have refused to join nonproliferation efforts. Apparently, India was offered such enticements to try to convince it to participate in a cutoff.[6]

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[5]Verification would become much more important to the United States if further international agreements were to lead to limitations on stockpiles of fissile materials, and their being placed under international safeguards. Once fissile materials stockpiles are drawn down to a very low level, secret production could give substantial advantage to an opponent in a breakout scenario.

[6]Private discussions between author and US government officials.

Valuable Diplomatic Energies Are Consumed

A few nations, like the United States, have large bureaucracies and many diplomatic personnel who can be devoted to arms control negotiations. Most others have only one person or a few people who work on the international arms control agenda, and many of these are people who spend only part time on the topic. In Geneva, for example, some nations use the same representative to cover the Conference on Disarmament as they assign to other Geneva-based international fora and meetings. To a large degree, this leads to a zero-sum game in arms control: Adding one subject to an arms control agenda diminishes the available attention for any other issue that might arise.

In the post-Cold War world, arms control negotiations are very properly realigning from a focus on East-West, US–Soviet arms negotiations to more global considerations. It is in this context that interest in a fissile materials cutoff has been resuscitated and given a new purpose—nonproliferation. Yet, given the limited diplomatic energies available for *international* arms control, is a cutoff convention the most productive objective? Would it not be more beneficial to focus diplomatic energies on efforts with greater payoff potential such as internationalizing the Intermediate Nuclear Forces Treaty or modeling regional agreements on the Conventional Forces in Europe Treaty?

The Cutoff Is Extremely Expensive

Financial costs of the cutoff will be of two types: those that are paid to obtain some countries' participation in the agreement, and those paid for implementation. Regarding the first category, increasingly, the United States, perhaps in concert with allies, has paid money or in-kind assistance to nations in return for their undertaking arms control-related activities. Two recent examples are: the promise by the United States to North Korea to provide $500 million in fuel oil as part of an agreement[7] to convince Pyongyang to abide by the NPT, to which it is a signatory; and the provision to Kazakhstan by the United States of hundreds of millions of dollars in assistance in return for some 600 kg of highly enriched uranium—an agreement called "Project Sapphire."[8]

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[7]The agreement provides much more than just fuel oil. South Korea and Japan are pledging the lion's share of $4 billion worth of light-water reactors to North Korea. The United States expects to contribute at least $30 million/year to participate in the reactor program and has provided additional funds (e.g., $10 million to clean and stabilize the spent nuclear fuel storage ponds in North Korea).

[8]Clinton Administration officials refuse to reveal publicly the exact amount of money paid to Kazakhstan, citing fears that other nations will use it as a baseline from which to strike their own bargains with the United States in the future.

Obtaining Russia's participation in a fissile material cutoff will be particularly expensive. Russia is often cited by US officials and reported in the US press as having agreed to give up its fissile materials production by the year 2000. That is only half of the Russian statement; the other half is usually unmentioned because therein lies the rub. Russia's condition for shutting down its plutonium production reactors is replacement of its one Krasnoyarsk and two Tomsk reactors—reactors whose fuel currently must be reprocessed, yielding approximately 1.5 tons/year of plutonium. The cost for replacing the three probably would be $6 billion at a minimum, and perhaps several times that, depending on the type of replacement, the shutdown and clean-up costs, and time for design and building.

Large costs also will be entailed in implementing any cutoff, even if an existing body, the IAEA, were used as the implementing organization. The principal job of the IAEA in implementing a cutoff would be to try to prevent cheating at declared sites or with declared materials; the IAEA would be able to do little, if anything, to detect undeclared, clandestine facilities.

All enrichment and reprocessing facilities would have to be regularly inspected, including plants that have been shut down, as well as enrichment plants that ostensibly produce only low-enriched product.[9] At some uranium enrichment facilities, the IAEA would be required to conduct very frequent, detailed on-site inspections, both to make sure that the plants are not reconfigured briefly to manufacture HEU and to assure that any non-weapons HEU is not diverted for weapons. Thus, the IAEA would be required to increase significantly the number of facilities it inspects[10] and would have to change the nature of inspections to make them more frequent and more rigorous.

Conclusion

The principal benefit of a successful cutoff will be a political agreement by Israel, India, and Pakistan to cease new production of fissile

[9]This argument has been made by Waldo Stumpf, Chief Executive Officer of the Atomic Energy Corporation of South Africa, who warns that it is feasible to secretly restart a closed facility or reconfigure a low-enriched uranium plant to make highly enriched uranium. See Waldo E. Stumpf, "Effects of a Special Nuclear Weapon Materials Cutoff Convention," in *Director's Series on Proliferation*, Volume 6, Lawrence Livermore National Laboratory, Livermore, CA, UCRL-LR-114070-6, October 17, 1994, p. 38.

[10]Non-nuclear weapons states would be unwilling to accept a convention that does not require permanent safeguards on all relevant fissile materials facilities. In the United States alone, this would entail applying safeguards on 230 facilities. See Stumpf, "Effects of a Special Nuclear Weapon Materials Cutoff Convention," p. 42.

materials for weapons. (Recall that NPT non-nuclear weapons states already are committed to not producing fissile materials, and Russia and the United States do not need new fissile materials.) If the cutoff is truly to be nondiscriminatory, the unaffected items will be existing stockpiles, declared or undeclared; new production for non-weapons purposes; and ever-increasing quantities of reactor-grade plutonium usable in weapons.

There are several drawbacks to the cutoff proposal. A key issue is that current technologies do not allow for effective verification of a fissile materials cutoff. Equally important, the cutoff has the potential to damage the NPT by creating a new, less restrictive arms control accord that other nations may eventually prefer. There are other costs as well. International diplomatic energies will be sapped. The costs of inspections and other verification activities—activities that will offer little assurance that cheating is not under way—will be high. In summary, the costs of the fissile materials cutoff appear to outweigh the benefit.

6

The United Nations Special Commission on Iraq: A Period of Transition

*Terence Taylor**

Under the terms of the cease fire resolutions at the end of the 1991 Gulf War, Iraq was required to destroy and dismantle all of its weapons of mass destruction, including ballistic missiles with a range of more than 150 km, as well as their associated production and research and development facilities. The resolutions also required full disclosure of Iraq's past programs, which is essential for on-site monitoring by the UN Special Commission on Iraq (UNSCOM) and the International Atomic Energy Agency (IAEA) to ensure continuing compliance. Once UNSCOM and the IAEA are satisfied that all weapons are destroyed, that a full disclosure has been made on the weapons programs, and that a long-term compliance and monitoring system is fully operational, the stage will be set for a political decision to end the trade embargo against Iraq. Some permanent members of the Security Council, in particular France and Russia, have been exerting political pressure to hasten UNSCOM and the IAEA to give Iraq a clean bill of health so that lucrative trade can begin again. However, much remains to be done to be confident that the Iraqis are not still hiding elements of their past programs and to ensure that the compliance and monitoring system is fully effective.

The Executive Chairman of UNSCOM, Ambassador Rolf Ekeus, reported to the Security Council on April 11, 1995, that the ongoing monitoring and verification system in Iraq was operational. However, some technical systems are yet to be installed and properly tested, and more information must be collected in certain areas to complete the

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database on which successful monitoring heavily depends. In preparing for this phase, UNSCOM, in cooperation with the IAEA, has had to broaden significantly its inspection activities to cover all military and civilian facilities that have a capability to contribute to weapons of mass destruction and ballistic missile programs. The objective of detecting and destroying prohibited weapons and equipment has given way to investigative work to acquire data, as well as to the challenging technical task of setting up the Baghdad Monitoring and Verification Center (BMVC), including systems at UN Headquarters in New York, to handle and analyze large amounts of data. Not only do nuclear, biological, chemical, and missile facilities have to be monitored, but also an import/export regime must be in place to cover all prohibited and dual use items relevant to these facilities. This major task is, not surprisingly, taking substantial time to set up. The system must be fully operational the moment the trade restrictions are eased.

Following the Iraqi decision to accept UN Security Council (SCR) 715—the mandate for ongoing compliance monitoring—Iraqi cooperation with UNSCOM and the IAEA improved considerably. There was a significant change from the deception and subterfuge practiced in the first two years or so of the UN and IAEA operation to find and destroy the Iraqi weapons programs. The incentive to remove one of the major obstacles to the lifting of sanctions has clearly had an effect. Even during the period of political tension surrounding the Iraqi troop movements toward the Kuwaiti border in November 1994, cooperation with UN inspectors in Iraq at the operational level appeared unaffected. However, this cooperation has not been as complete as it should be in certain areas, particularly with regard to the history of past weapons programs and the procurement network. Much of the information Iraq has given was handed over grudgingly under pressure or when Iraq was presented with evidence obtained from sources of member states participating in UNSCOM's activities. One of the areas most lacking in information is Iraq's biological weapons (BW) program. Thus, an intensive inspection and interrogation effort has been needed in recent months to seek out the full details. This work is not yet complete, and deception continues to be practiced by the Iraqis with regard to their BW program. This prevented the lifting of sanctions by the Security Council last April.

The other essential building block in preparing the monitoring and compliance system is to build a database of all the facilities that have capabilities relevant to the prohibited activities. This task has been the main preoccupation of the inspection activities during the past six months. Through a process of declarations by the Iraqis and on-site

inspections, facilities and equipment have been identified and a detailed database is being constructed. The facilities concerned include military and civilian sites (both government and privately owned). For key dual-capable equipment, an inventory has been drawn up and the equipment is being tagged so its use can be closely monitored. UNSCOM and the IAEA must be notified before tagged equipment can be moved. The database will be maintained through a system of periodic declarations from the Iraqis and on-site inspections. This task has involved visits to facilities ranging from nuclear sites and chemical production plants to dairy factories producing yogurt. Such an effort has required UNSCOM to seek a wide range of skills and expertise to inspect the facilities and analyze the information.

The inspections to collect data, known as baseline inspections, are most advanced in the nuclear and ballistic missile areas. The site visits are completed, and UNSCOM and the IAEA are completing their analysis of the data, from which they have prepared protocols for each of the facilities concerned. In the case of missiles, for example, this involves some 30 separate facilities. These protocols contain all of the data and site diagrams necessary to conduct future on-site monitoring. In the chemical area, the protocols are also nearly complete for about 50 facilities. The last to be ready were those for the biological facilities involving more than 70 sites. In December 1994, some sites of biological interest were being inspected for the first time. The delay is caused not only by the larger number of sites, but also by the paucity of information given by the Iraqis on their biological weapons program. Thus, UNSCOM must cast the net widely to catch all conceivable dual-capable facilities.

An important component in the monitoring system is the Baghdad Monitoring and Verification Center. The BMVC houses the staff and communications equipment that receive data from the on-site monitoring devices. These devices include such equipment as optical cameras, flow meters, and air samplers. By the end of January 1995, more than 100 cameras and over 20 air samplers were installed at many different sites throughout Iraq. More are planned at other sites. The Center will also have a limited capability to analyze samples from the monitoring devices as well as those taken by the UNSCOM and IAEA monitoring teams during on site inspections. For example, a chemical laboratory has been installed including such equipment as a gas chromatography mass spectrometer. The Center also has an aerial surveillance capability with an associated photographic laboratory and expert analysts.

In addition to the deployment of remote sensing devices, inspections will continue. They will be conducted by properly qualified experts in

all the fields involved and will be both routine and "no notice" in character. The inspections will range from visits to specific facilities to general environmental monitoring of soil, air, and water, and they can take place at both declared and undeclared facilities at any time. The BMVC is not yet operating at full effectiveness, and the efficiency of the remote sensing devices will have to be proved before there can be full confidence in their operation. For example, direct communications links with remote cameras more than 100 km from Baghdad have yet to be established; this is expected to be resolved by the end of June 1995. Some of the equipment being used is being deployed in the field for the first time under very harsh climatic conditions. From a purely technical standpoint, at least six months' operation of the full system would be needed to have a reasonable measure of confidence in its effectiveness.

All the features of the long-term compliance and monitoring plan so far discussed deal with the internal regime in Iraq. An external regime, an export/import monitoring mechanism, is being set up and will come into operation once sanctions are lifted. A joint UNSCOM/IAEA group has drawn up a plan for a regime based on lists of equipment and materials, which fall into two categories: (1) prohibited items and (2) items for which notification of the intention to acquire must be given by both Iraq and the exporter. Specialist staff will be based at the BMVC in Baghdad to speedily process import notifications in cooperation with UN Headquarters in New York. Seminars have been held involving major exporting countries to ensure that the lists of equipment and materials are accurate and relevant, and to refine the system so that it is not overly bureaucratic and can be easily operated by Iraq's potential suppliers. The external regime dovetails into the internal regime in the accounting and tracking of tagged equipment within Iraq. It is hoped to have the plan completed and endorsed by the Security Council in the near future.

In conclusion, there is some way to go before the long-term compliance and monitoring plan will be fully in effect. The reasons for this are both technical and political. The deployment of the remote monitoring systems must be completed and their performance proved and evaluated. The efficacy of the on-site inspection system must be properly tested. The whole plan is heavily dependent on Iraqi cooperation, which must be demonstrated over time. The past and present Iraqi attempts at deception and economy with the truth do not offer a great deal of encouragement. The Iraqis still have not been fully open about their past programs and international procurement system. Therefore, UNSCOM and the IAEA cannot be confident that the compliance monitoring system is not flawed. The Iraqis have gained a great deal of experience in

receiving inspections, and future inspectors will require great skill and determination to avoid being duped. This will be the biggest danger when the long term plan has become a routine matter not attracting a high level of political and media attention.

Since the Iraqi formal recognition of the Kuwaiti borders, the Security Council has been under even more political pressure to lift the trade sanctions against Iraq. It is essential that consensus is maintained in the Security Council to resist such pressure until the members are completely satisfied that a system is in place and can effectively contribute to the effort to prevent Iraq from reconstituting its weapons of mass destruction and ballistic missile programs. From the technical point of view, at least six months is required to ensure the system is as effective as practicably possible. From the political point of view, the period might be longer or shorter depending on whether or not the economic imperative wins the day and the nature of the consensus in the Security Council is altered. Once sanctions are lifted, leverage on Iraq to maintain full compliance with the monitoring plan will be significantly diminished. Therefore, it is essential to maintain pressure on Iraq now for full disclosure of their past programs and to ensure that the monitoring system is working as efficiently as possible. A hasty decision to declare Iraq in full compliance with the cease fire resolutions could bode ill for long-term security in the Middle East and Gulf regions.

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